Anatomy: Forearm and Hand



Question 1 of 102

A 23 year old woman sustains a laceration injury to her posterior forearm. Which of the following muscles would you least expect to be affected in this injury:

a Abductor pollicis longus

b Supinator

c Brachioradialis

d Brachialis

e Extensor digiti minimi

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Anatomy: Forearm and Hand

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a) Abductor pollicis longus
b) Supinator
c) Brachioradialis
d) **Brachialis** ✔
e) Extensor digiti minimi

Answer

The brachialis is found in the anterior arm.

Notes

The muscles of the posterior forearm are all innervated by the radial nerve.

The posterior forearm is divided into the superficial and deep groups:

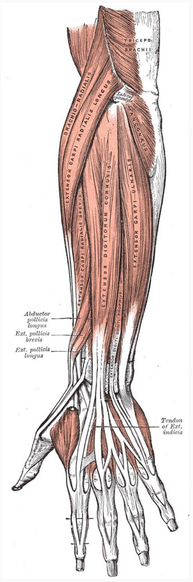
- The superficial group is made up of the brachioradialis, the extensor carpi radialis longus and brevis, the extensor digitorum, the extensor digiti mini, the anconeus and the extensor carpi ulnaris.
- The deep group is made up of the supinator, the abductor pollicis longus, the extensor pollicis longus and brevis and the extensor indicis.

Muscle	Action	Innervation
Brachioradialis	Flexion of elbow	Radial nerve
Extensor carpi radialis longus	Extension and abduction of wrist	Radial nerve
Extensor carpi radialis brevis	Extension and abduction of wrist	Radial nerve
Extensor digitorum	Extension of all four fingers, extension of wrist	Radial nerve
Extensor digiti minimi	Extension of little finger	Radial nerve
Extensor carpi ulnaris	Extension and adduction of wrist	Radial nerve
Supinator	Supination of forearm	Radial nerve
Abductor pollicis longus	Abduction and extension of thumb	Radial nerve
Extensor pollicis longus	Extension of thumb (CMCJ, MCPJ, IPJ)	Radial nerve
Extensor pollicis brevis	Extension of thumb (CMCJ and MCPJ)	Radial nerve
Extensor indicis	Extension of index finger	Radial nerve

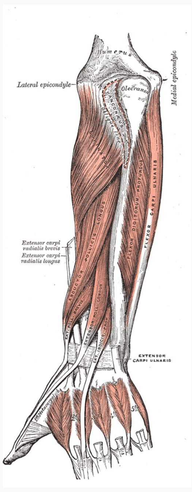
A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The abductor pollicis longus is attached distally to the lateral side of base of the 1st metacarpal.
- The extensor pollicis brevis is attached to the proximal phalanx of the thumb and the extensor pollicis longus is attached to the distal phalanx of the thumb.
- The extensor carpi radialis longus is attached to the base of the 2nd metacarpal and the extensor carpi radialis brevis is attached to the bases of the 2nd and 3rd metacarpals.
- The extensor digitorum is attached to the base of the middle and distal phalanges of digits 2 – 5 via extensor hoods.
- The extensor carpi ulnaris is attached to the base of the 5th metacarpal.
- The extensor digiti minimi is attached to the base of the 5th metacarpal.
- The extensor indicis is attached to the extensor hood of the index finger.

Muscle tendon	Distal attachment
Extensor carpi radialis longus	Dorsal surface of base of 2nd metacarpal
Extensor carpi radialis brevis	Dorsal surface of base of 2nd and 3rd metacarpal
Extensor digitorum	Dorsal aspects of bases of middle and distal phalanges of all four fingers via extensor hoods
Extensor carpi ulnaris	Tubercle on base of medial 5th metacarpal
Abductor pollicis longus	Lateral side of base of 1st metacarpal
Extensor pollicis longus	Dorsal surface of base of distal phalanx of thumb
Extensor pollicis brevis	Dorsal surface of base of proximal phalanx of thumb
Extensor indicis	Extensor hood of index finger



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Question 2 of 102

A 76 year old man presents to the ED complaining of weakness in the right wrist. On examination you note weakness of flexion and abduction. You suspect a pathology of the flexor carpi radialis. The flexor carpi radialis is attached distally to which of the following structures:

a Scaphoid and trapezoid

b Scaphoid and base of 2nd metacarpal

c Base of 2nd and 3rd metacarpal

d Trapezium and base of 1st metacarpal

e Scaphoid, trapezium and base of 1st metacarpal

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Question 2 of 102

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a) Scaphoid and trapezoid
b) Scaphoid and base of 2nd metacarpal
c) **Base of 2nd and 3rd metacarpal** ✔
d) Trapezium and base of 1st metacarpal
e) Scaphoid, trapezium and base of 1st metacarpal

Answer

The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

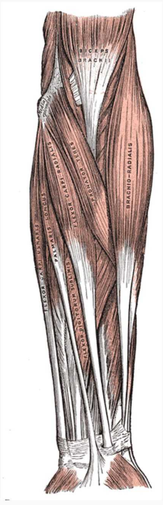
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

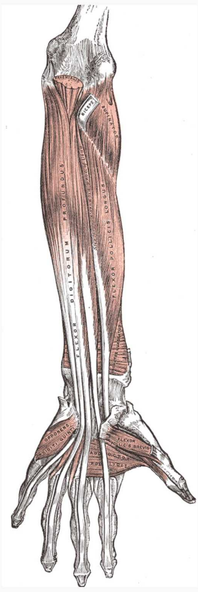
The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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Anatomy: Forearm and Hand



Question 3 of 102

A 21 year old mechanic presents to ED after sustaining a crush injury to his middle finger whilst at work. Which of the following muscles is least likely to be affected:

a Flexor digitorum profundus

b Palmar interossei

c Dorsal interossei

d Lumbrical

e Extensor digitorum

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Anatomy: Forearm and Hand



Question 3 of 102

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a) Flexor digitorum profundus
b) Palmar interossei ✔
c) Dorsal interossei
d) **Lumbrical** ✘
e) Extensor digitorum

Answer

The palmar interossei insert into the extensor hoods of the index, ring and little finger; there is no palmar interosseus attaching to the middle finger and hence it is least likely to be affected in this injury.

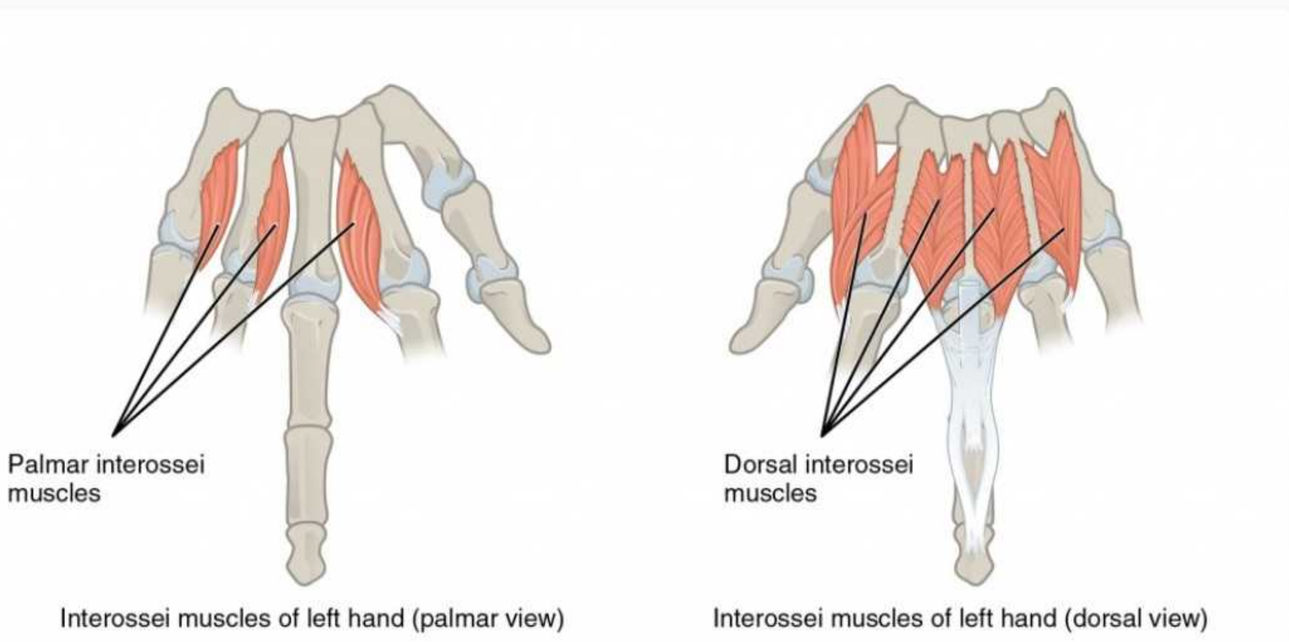
Notes

The interosseous muscles originate from and lie between the metacarpal bones. The dorsal interossei insert into the extensor hoods and proximal phalanges of the index, middle and ring finger. The palmar interossei insert into the extensor hoods of the index, ring and little finger.

The four dorsal interossei act to abduct the index, middle and ring fingers, and the three palmar interossei act to adduct the index, ring and little fingers. (DAB, PAD). Because the interosseous muscles insert into the extensor hoods, they also contribute to the complex flexion and extension movements of the interphalangeal joints of the digits.

The interosseous muscles are all innervated by the ulnar nerve.

Muscle	Action	Innervation
Dorsal interossei	Abduction of fingers at MCPJ	Ulnar nerve
Palmar interossei	Adduction of fingers at MCPJ	Ulnar nerve



Interossei muscles of left hand (palmar view) Interossei muscles of left hand (dorsal view)

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Anatomy: Forearm and Hand



Question 4 of 102

A 47 year old secretary presents to the ED complaining of pain in the left wrist. After examination you suspect carpal tunnel syndrome. Which of the following structures passes through the carpal tunnel:

a Tendon of the flexor carpi radialis

b Ulnar artery

c Ulnar nerve

d Tendon of the palmaris longus

e Tendon of the flexor pollicis longus

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Question 4 of 102

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a) Tendon of the flexor carpi radialis
b) Ulnar artery
c) Ulnar nerve
d) Tendon of the palmaris longus
e) **Tendon of the flexor pollicis longus** ✔

Answer

The tendons of the flexor pollicis longus, flexor digitorum superficialis and flexor digitorum profundus pass through the carpal tunnel. The ulnar nerve and ulnar artery pass into the hand anterior to the flexor retinaculum and carpal tunnel.

Notes

Anatomical Boundaries	Structure
Roof	Flexor retinaculum
Carpal arch	Pisiform and hook of the hamate medially, tubercles of the scaphoid and trapezium laterally
Contents	Four tendons of flexor digitorum profundus, four tendons of flexor digitorum superficialis, tendon of flexor pollicis longus, median nerve

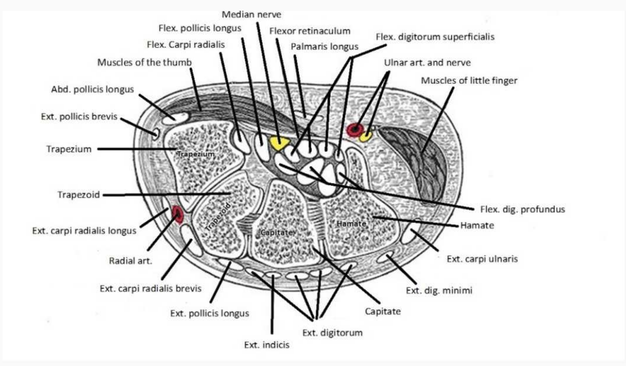
The carpal tunnel is formed by a deep carpal arch and a superficial flexor retinaculum. The base of the carpal tunnel is formed medially by the pisiform and the hook of the hamate and laterally by the tubercles of the scaphoid and trapezium. The flexor retinaculum is a thickened band of fibrous connective tissue on the volar aspect of the hand, which bridges the gap between these carpal bones and forms the roof of the carpal tunnel.

The following structures pass through the carpal tunnel:

- the four tendons of the flexor digitorum profundus (FDP)
- the four tendons of the flexor digitorum superficialis (FDS)
- the tendon of the flexor pollicis longus (FPL)
- the median nerve.

Free movement of the tendons in the carpal tunnel is facilitated by synovial sheaths, which surround the tendons. All of the tendons of the FDP and FDS are contained within a single synovial sheath with a separate sheath enclosing the tendon of the FPL. The median nerve lies anterior to the tendons in the carpal tunnel.

Carpal tunnel syndrome is caused by compression of the median nerve within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 5 of 102

A patient sustains an injury to the anterior forearm after falling from a bicycle. Which of the following muscles would you least expect to be affected in this injury:

a Palmaris longus

b Brachioradialis

c Pronator quadratus

d Pronator teres

e Flexor digitorum profundus

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Question 5 of 102

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a) Palmaris longus
b) **Brachioradialis** ✔
c) Pronator quadratus
d) Pronator teres
e) Flexor digitorum profundus

Answer

The brachioradialis is a muscle of the posterior compartment of the forearm. It acts to flex the forearm at the elbow.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

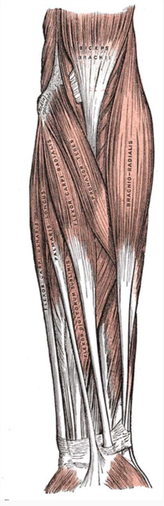
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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Question 6 of 102

A patient sustains an injury to the radial nerve through a midshaft humeral fracture. Which of the following clinical findings would you least expect to see in this patient:

a Wrist drop

b Loss of extension of the forearm

c Loss of extension of the fingers

d Weakness of supination

e Loss of sensation over the dorsum of the lateral three and a half digits.

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Question 6 of 102

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a) Wrist drop
b) **Loss of extension of the forearm** ✔
c) Loss of extension of the fingers
d) Weakness of supination
e) Loss of sensation over the dorsum of the lateral three and a half digits.

Answer

The radial nerve innervates the triceps brachii and the posterior compartment of the forearm. The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

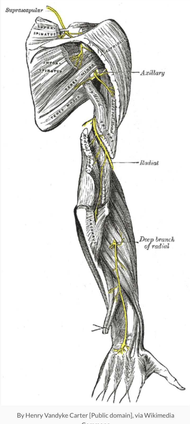
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 7 of 102

A 29 year old male presents to ED having falling awkwardly during a judo match. On examination he is unable to flex his index and middle fingers at the metacarpophalangeal or interphalangeal joints and unable to flex the distal phalanx of his thumb. He has loss of sensation over the lateral palm and fingers. Which of the following nerves has most likely been injured, and at what level:

a Anterior interosseous nerve i the proximal forearm

b Median nerve in the cubital fossa

c Ulnar nerve at the elbow

d Median nerve at the wrist

e Radial nerve in the midarm

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Question 7 of 102

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a) Anterior interosseous nerve i the proximal forearm
b) Median nerve in the cubital fossa ✔
c) Ulnar nerve at the elbow
d) Median nerve at the wrist
e) Radial nerve in the midarm

Answer

The most likely injury is the median nerve at the cubital fossa. The patient has loss of flexion at the MCPJ and IPJ of the index and middle finger caused by paralysis of the lateral two lumbricals and the flexor digitorum profundus and flexor digitorum superficialis. Loss of flexion of the distal phalanx of the thumb results from paralysis of the flexor pollicis longus. The anterior interosseous nerve, branch of the median nerve, has no cutaneous function. Median nerve injury at the wrist would spare the forearm flexor muscles.

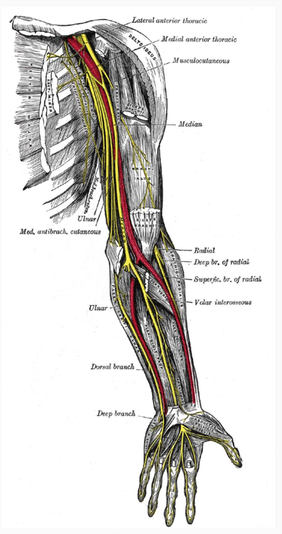
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 8 of 102

A 28 year old man presents to ED having falling off his bike. Imaging shows fracture of the medial epicondyle and ulnar nerve injury. Which of the following muscles will most likely be affected:

a Flexor digitorum superficialis

b Supinator

c Brachialis

d Brachioradialis

e Flexor digitorum profundus

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Question 8 of 102

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a) Flexor digitorum superficialis
b) Supinator
c) Brachialis
d) Brachioradialis
e) **Flexor digitorum profundus** ✔

Answer

The ulnar nerve innervates the medial half of the flexor digitorum profundus and the flexor carpi ulnaris in the forearm and most of the intrinsic muscles of the hand (except for the lateral two lumbricals, and the thenar muscles, innervated by the median nerve). The flexor digitorum superficialis is innervated by the median nerve. The brachialis is innervated by the musculocutaneous nerve. The brachioradialis and the supinator are innervated by the radial nerve.

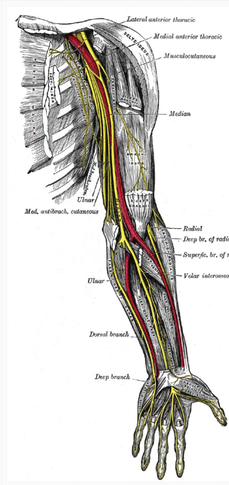
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the *anterior compartment* of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting. N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrether (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 9 of 102

A 34 year old woman sustains a midshaft humerus fracture with nerve damage falling off a horse. Which of the following movements would most likely be affected by this injury:

a Abduction of the arm

b Pronation of the forearm

c Extension of the forearm

d Extension of the wrist

e Extension of the arm

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Anatomy: Forearm and Hand

Question 9 of 102

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a) Abduction of the arm
b) Pronation of the forearm
c) Extension of the forearm
d) **Extension of the wrist** ✔
e) Extension of the arm

Answer

The radial nerve innervates the muscles of the posterior arm and forearm, primarily involved in extension of the forearm, wrist and fingers (and supination of the forearm). Damage to this nerve in the mid humerus is likely to spare the triceps brachii muscle, so you would not expect loss of extension of the forearm or arm. The pronators of the forearm are innervated by the median nerve. Abduction of the arm is primarily produced by the deltoid and supraspinatus innervated by the axillary nerve and suprascapular nerve respectively.

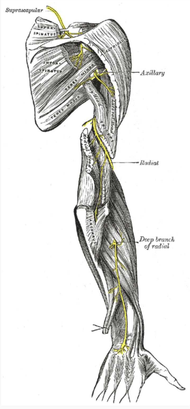
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 10 of 102

A patient sustains a fracture of the midshaft of the humerus with resultant damage to the radial nerve. He has wrist drop and is unable to extend his fingers. He is still able to supinate his forearm. Supination of the forearm is still possible through the action of which of the following muscles:

a Supinator

b Coracobrachialis

c Biceps brachii

d Brachialis

e Supraspinatus

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a) Supinator
b) Coracobrachialis
c) **Biceps brachii** ✔
d) Brachialis
e) Supraspinatus

Answer

Supination of the forearm is primarily produced by the supinator (radial nerve) and the biceps brachii (musculocutaneous nerve). Radial nerve damage will result in paralysis of the supinator muscle, but the biceps brachii muscle function is preserved.

Notes

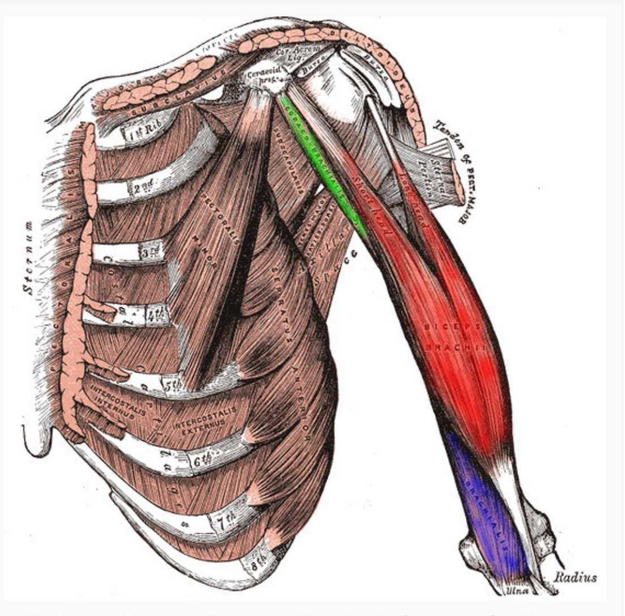
The anterior compartment of the arm consists of three muscles.

Muscle	Actions	Innervation
Coracobrachialis	Flexion of arm	Musculocutaneous nerve (C5 – C7)
Biceps brachii	Flexion and supination of forearm, flexion of arm	Musculocutaneous nerve (C5, C6)
Brachialis	Flexion of forearm	Musculocutaneous nerve (C5, C6); small contribution by radial nerve (C7) to lateral muscle

The coracobrachialis (green) is innervated by the musculocutaneous nerve (C5 – C7). It acts to flex the arm at the glenohumeral joint.

The biceps brachii (red) is innervated by the musculocutaneous nerve (C5 – C6). The biceps is primarily a powerful flexor and supinator of the forearm at the elbow joint. It also assists with flexion of the arm at the shoulder joint (with the coracobrachialis muscle). The biceps reflex tap predominantly tests spinal cord segment C6.

The brachialis (blue) is innervated primarily by the musculocutaneous nerve (C5, C6) with a small contribution from the radial nerve (C7). The brachialis flexes the forearm at the elbow joint.



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Anatomy: Forearm and Hand



Question 11 of 102

A 82 year old woman is brought to the ED by her son. She complains of numbness in her fingers, her son was concerned this may have been a stroke. On examination you note loss of sensation to the skin over the palmar surface of the medial one and a half digits. This area is supplied by which of the following nerves:

a The superficial branch of the radial nerve

b The palmar cutaneous branch of the median nerve

c The palmar cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The palmar digital branch of the median nerve

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Anatomy: Forearm and Hand

Question 11 of 102

A 82 year old woman is brought to the ED by her son. She complains of numbness in her fingers, her son was concerned this may have been a stroke. On examination you note loss of sensation to the skin over the palmar surface of the medial one and a half digits. This area is supplied by which of the following nerves:

a) The superficial branch of the radial nerve
b) The palmar cutaneous branch of the median nerve
c) The palmar cutaneous branch of the ulnar nerve
d) **The superficial branch of the ulnar nerve** ✔
e) The palmar digital branch of the median nerve

Answer

The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

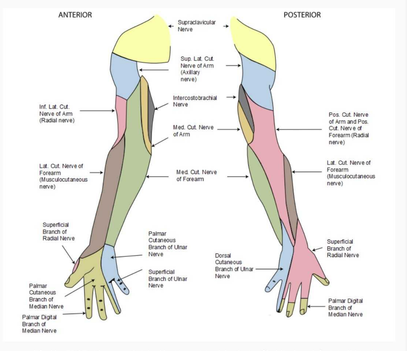
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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You have been asked to review a patient in the Minor Injuries Unit. The 32 year old sustained a laceration to the forearm during a fight. He has lost sensation over the medial dorsum of the hand and the dorsum of the medial one and a half digits. This area is supplied by which of the following nerves:

a The superficial branch of the radial nerve

b The deep branch of the radial nerve

c The dorsal cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The digital branch of the median nerve

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a) The superficial branch of the radial nerve
b) The deep branch of the radial nerve
c) **The dorsal cutaneous branch of the ulnar nerve** ✔
d) The superficial branch of the ulnar nerve
e) The digital branch of the median nerve

Answer

The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
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Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

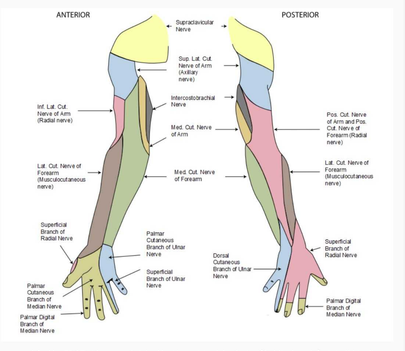
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- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 13 of 102

A 56 year old illustrator presents to the ED with a 3 day history of right wrist pain. He is concerned as this is affecting his work. On examination you note crepitations on flexion and extension of the wrist, you suspect an arthritis to be responsible. The wrist joint is formed by articulations between which of the following bones:

a Distal radius, distal ulna and scaphoid

b Distal radius, scaphoid, lunate and triquetrum

c Distal radius, distal ulna and pisiform

d Distal radius, triquetrum and trapezoid

e Distal radius, scaphoid and hamate

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Anatomy: Forearm and Hand

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a) Distal radius, distal ulna and scaphoid
b) **Distal radius, scaphoid, lunate and triquetrum** ✔
c) Distal radius, distal ulna and pisiform
d) Distal radius, triquetrum and trapezoid
e) Distal radius, scaphoid and hamate

Answer

The wrist joint is a synovial condyloid joint occurring between the distal end of the radius and the articular disc overlying the distal end of the ulna and the scaphoid, lunate and triquetrum.

Notes

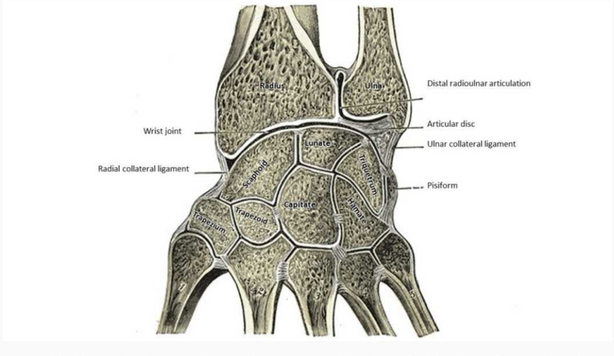
Joint	Wrist joint
Type	Synovial condyloid joint
Articulations	Distal end of the radius and articular disc with scaphoid, lunate and triquetrum
Stabilising factors	Joint capsule, palmar radiocarpal, palmar ulnocarpal and dorsal radiocarpal ligaments, radial and ulnar collateral ligaments of the wrist joint
Movements	Flexion and extension, abduction and adduction

The wrist joint is a synovial condyloid joint occurring between the distal end of the radius and the articular disc overlying the distal end of the ulna and the scaphoid, lunate and triquetrum.

The capsule of the wrist joint is reinforced by palmar radiocarpal, palmar ulnocarpal and dorsal radiocarpal ligaments. The radial and ulnar collateral ligaments of the wrist joint reinforce the medial and lateral sides of the wrist joint.

The wrist joint allows movement around two axes; the hand can be abducted and adducted, and flexed and extended at the wrist joint.

Movement	Muscles Involved
Flexion	Flexor carpi radialis, flexor carpi ulnaris, flexor digitorum profundus, flexor digitorum superficialis, palmaris longus
Extension	Extensor carpi radialis longus and brevis, extensor carpi ulnaris, extensor digitorum
Abduction	Flexor carpi radialis, extensor carpi radialis longus and brevis
Adduction	Flexor carpi ulnaris, extensor carpi ulnaris



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Question 14 of 102

You are part of the trauma team caring for a 18 year old horse rider who fell when jumping a fence. She is complaining of pain in her neck. Whilst awaiting imaging your consultant asks you to perform a brief neurological assessment. She is tender over the C7 and T1 vertebrae. The C7 dermatome is best tested at which of the following landmarks:

a Dorsum of middle finger

b Dorsum of little finger

c Dorsum of thumb

d Medial antecubital fossa

e Lateral antecubital fossa

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Question 14 of 102

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b) Dorsum of little finger
c) Dorsum of thumb
d) Medial antecubital fossa
e) Lateral antecubital fossa

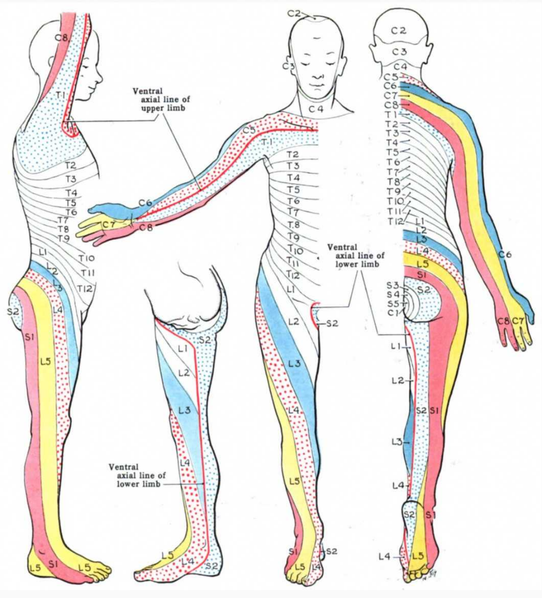
Answer

The C7 dermatome is best tested on the dorsal surface of the proximal phalanx of the middle finger.

Notes

Dermatome	Landmark
C2	Occipital Protuberance
C3	Supraclavicular Fossa
C4	Acromioclavicular Joint
C5	Lateral Antecubital Fossa
C6	Thumb
C7	Middle Finger
C8	Little Finger
T1	Medial Antecubital Fossa
T2	Apex of Axilla

- The C2 dermatome is best tested at least one cm lateral to the occipital protuberance at the base of the skull. Alternately, it can be located at least 3 cm behind the ear.
- The C3 dermatome is best tested in the supraclavicular fossa, at the midclavicular line.
- The C4 dermatome is best tested over the acromioclavicular joint.
- The C5 dermatome is best tested on the lateral (radial) side of the antecubital fossa just proximal to the elbow.
- The C6 dermatome is best tested on the dorsal surface of the proximal phalanx of the thumb.
- The C7 dermatome is best tested on the dorsal surface of the proximal phalanx of the middle finger.
- The C8 dermatome is best tested on the dorsal surface of the proximal phalanx of the little finger.
- The T1 dermatome is best tested on the medial (ulnar) side of the antecubital fossa, just proximal to the medial epicondyle of the humerus.
- The T2 dermatome is best tested at the apex of the axilla.



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A 42 year old construction worker has sustained a penetrating injury to his left forearm. On examination, he is unable to form the 'ok' sign between his thumb and index finger due to weak flexion of the distal interphalangeal joints of these fingers. He is able to touch the pad of his little finger with his thumb. Which of the following nerves has most likely been affected:

a Recurrent branch of median nerve

b Anterior interosseous nerve

c Posterior interosseous nerve

d Palmar digital branch of the median nerve

e Deep branch of the ulnar nerve

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Question 15 of 102

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a) Recurrent branch of median nerve
b) **Anterior interosseous nerve** ✔
c) Posterior interosseous nerve
d) Palmar digital branch of the median nerve
e) Deep branch of the ulnar nerve

Answer

The anterior interosseous nerve, branch of the median nerve, innervates the flexor pollicis longus and the lateral half of the flexor digitorum profundus muscles which are responsible for flexion at the distal interphalangeal joint of the thumb and index finger respectively. Opposition is preserved, as this is controlled by the thenar muscles, innervated by the recurrent branch of the median nerve.

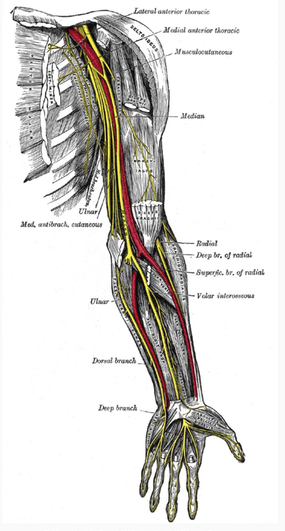
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the Index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Question 16 of 102

A 71 year old lady attends ED complaining of pain in her arm following a fall. Imaging demonstrates a midshaft humerus fracture. An injury of the radial nerve in the spiral groove would typically demonstrate which of the following physical signs:

a Weakness of forearm extension

b Weakness of thumb abduction and extension

c Weakness of thumb opposition

d Weakness of forearm pronation

e Weakness of abduction and adduction of the fingers

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a) Weakness of forearm extension
b) **Weakness of thumb abduction and extension** ✔
c) Weakness of thumb opposition
d) Weakness of forearm pronation
e) Weakness of abduction and adduction of the fingers

Answer

The radial nerve innervates the abductor pollicis longus and the extensor pollicis longus and brevis. Injury would therefore result in loss of extension and abduction of the thumb. The radial nerve does also innervate the triceps brachii, but injury at the mid humerus level usually spares this muscle and thus you would not expect weakness of forearm extension.

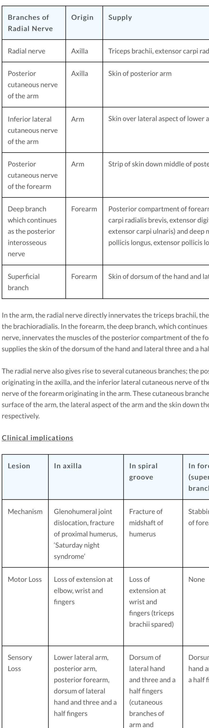
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 17 of 102

You have been asked to review a 32 year old pastry chef. She sustained a laceration to her left thenar eminence whilst working. Which of the following muscles is part of the thenar eminence:

a Extensor pollicis brevis

b Extensor pollicis longus

c Adductor pollicis

d Abductor pollicis longus

e Abductor pollicis brevis

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b) Extensor pollicis longus
c) Adductor pollicis
d) Abductor pollicis longus
e) **Abductor pollicis brevis** ✔

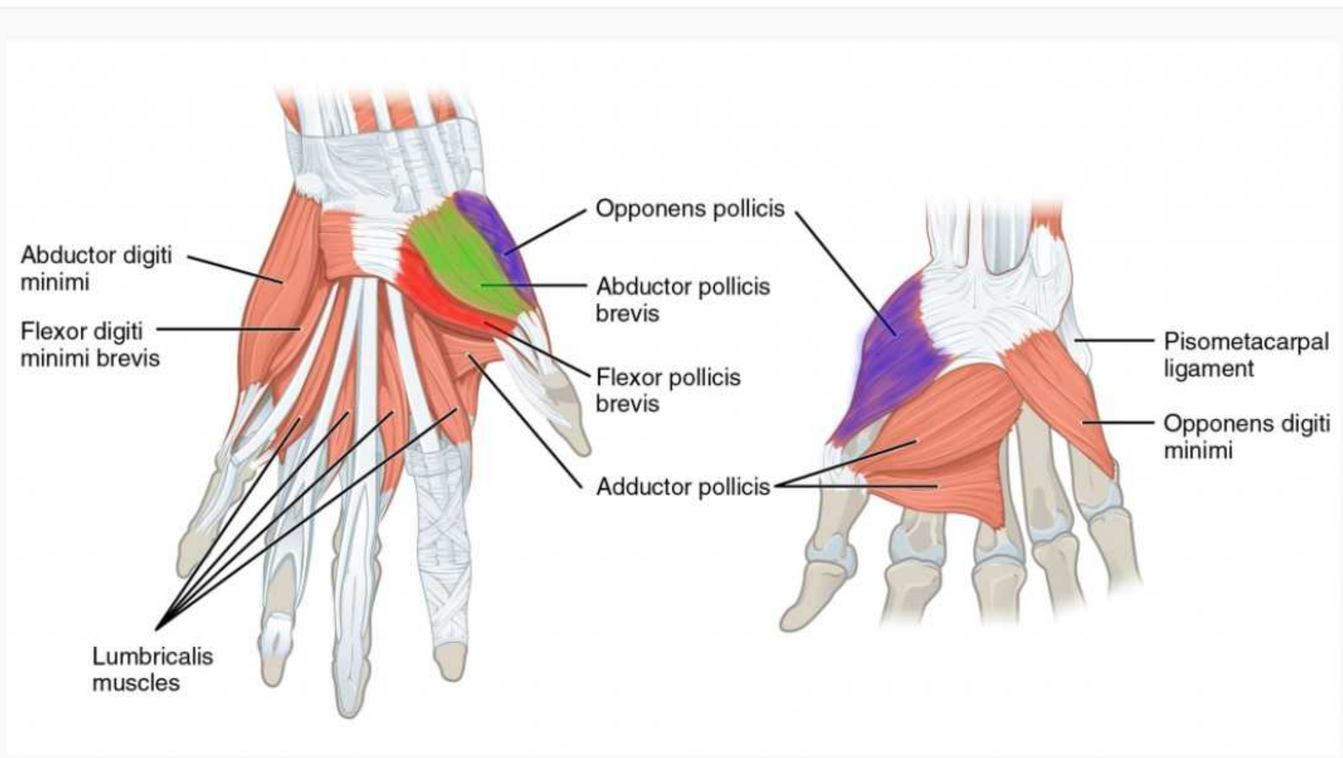
Answer

The thenar eminence consists of the opponens pollicis, the abductor pollicis brevis and the flexor pollicis brevis. The adductor pollicis is an intrinsic hand muscle, but not part of the thenar eminence. The extensor pollicis longus and brevis, and the abductor pollicis longus are found in the posterior forearm.

Notes

The thenar eminence consists of the opponens pollicis, the abductor pollicis brevis and the flexor pollicis brevis. The thenar muscles are all innervated by the median nerve.

Muscle	Action	Innervation
Opponens pollicis (blue)	Medially rotates thumb	Median nerve
Abductor pollicis brevis (green)	Abducts thumb at MCPJ	Median nerve
Flexor pollicis brevis (red)	Flexes thumb at MCPJ	Median nerve



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Anatomy: Forearm and Hand



Question 18 of 102

A 20 year old woman presents to ED with a painful swollen digit. Three days ago she attended with a dog bite that had penetrated the common flexor synovial sheath of the forearm. Which of the following digits is the most likely to be involved with spread of infection from this location:

a Thumb

b Index finger

c Middle finger

d Ring finger

e Little finger

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Anatomy: Forearm and Hand

Question 18 of 102

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a) Thumb ✗
b) Index finger
c) Middle finger
d) Ring finger
e) Little finger ✓

Answer

The synovial sheath of the little finger is usually continuous with the common flexor sheath of the forearm, unlike the middle three fingers which have separated synovial sheaths. The synovial sheath of the thumb is continuous with the synovial sheath of the flexor pollicis longus.

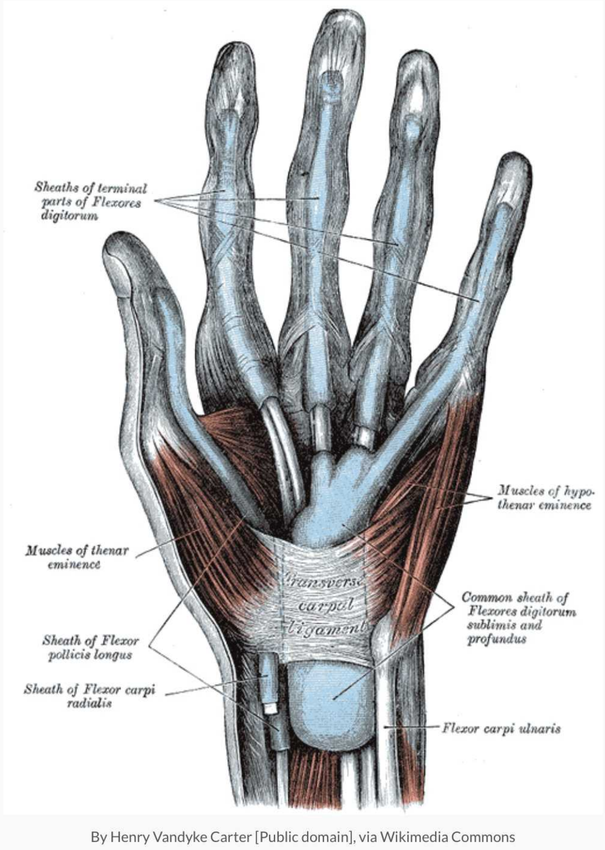
Notes

Tenosynovitis can be due to an infection of the synovial sheaths of the digits. Infections may occur in the digital synovial sheath for example after a puncture wound to a finger.

Infection in the middle three fingers is usually contained as they have separate synovial sheaths.

The synovial sheath of the little finger is usually continuous with the common flexor sheath (the ulnar bursa) and thus infection may spread to this sheath and from here to the midpalmar space.

Infections in the thumb may spread to the midpalmar space via the continuous synovial sheath of the flexor pollicis longus, also known as the radial bursa.



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Anatomy: Forearm and Hand



Question 19 of 102

You have been asked to give a tutorial to a group of medical students about upper limb neurology. You decide to cover the sensory supply to the upper limb. The skin over the medial half of the palm is supplied by which of the following nerves:

a The superficial branch of the radial nerve

b The palmar cutaneous branch of the median nerve

c The palmar cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The palmar digital branch of the median nerve

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Anatomy: Forearm and Hand

Question 19 of 102

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a) The superficial branch of the radial nerve
b) The palmar cutaneous branch of the median nerve
c) **The palmar cutaneous branch of the ulnar nerve** ✔
d) The superficial branch of the ulnar nerve
e) The palmar digital branch of the median nerve

Answer

The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

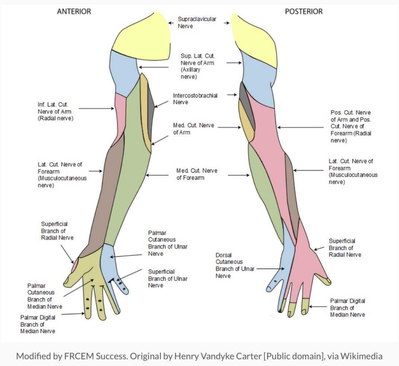
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 20 of 102

A 54 year old lady presents to ED having injured her left arm. She is complaining of weak hand grip of her left hand. The patient is unable to hold onto a piece of paper between her thumb and her index finger without flexing the distal joint of her thumb. Weakness of which of the following muscles causes this sign to appear:

- a Flexor pollicis brevis
- b Flexor pollicis longus
- c Adductor pollicis
- d Lumbricals
- e Opponens pollicis
- Abductor pollicis brevis

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Anatomy: Forearm and Hand

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a) Flexor pollicis brevis
b) Flexor pollicis longus
c) **Adductor pollicis** ✔
d) Lumbricals
e) Opponens pollicis
Abductor pollicis brevis

Answer

This is a positive Froment's sign, which is seen in ulnar neuropathy, caused by weakness of the adductor pollicis muscle.

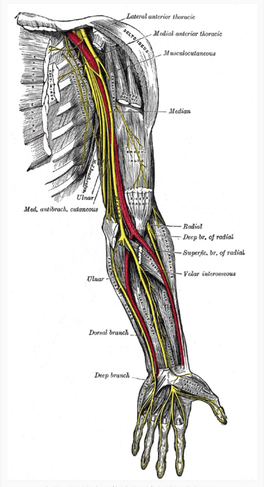
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand

Question 21 of 102

A 18 year patient old presents to ED having cut herself on the distal crease of her wrist. An image of her hand at rest is shown below. Paralysis to which of the following muscles is most likely responsible for this deformity:



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a Hypothenar muscles

b Interossei and medial two lumbricals

c Flexor digitorum profundus

d Extensor digitorum

e Extensor digiti minimi

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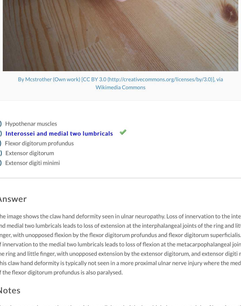
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Anatomy: Forearm and Hand

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a) Hypothenar muscles
b) **Interossei and medial two lumbricals** ✔
c) Flexor digitorum profundus
d) Extensor digitorum
e) Extensor digiti minimi

Answer

The image shows the claw hand deformity seen in ulnar neuropathy. Loss of innervation to the interossei and medial two lumbricals leads to loss of extension at the interphalangeal joints of the ring and little finger, with unopposed flexion by the flexor digitorum profundus and flexor digitorum superficialis. Loss of innervation to the medial two lumbricals leads to loss of flexion at the metacarpophalangeal joints of the ring and little finger, with unopposed extension by the extensor digitorum, and extensor digiti minimi. This claw hand deformity is typically not seen in a more proximal ulnar nerve injury where the medial half of the flexor digitorum profundus is also paralysed.

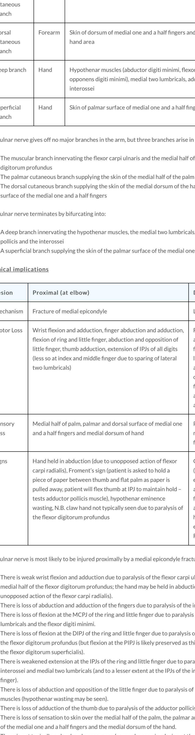
Notes

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Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches of Ulnar Nerve	Origin	Supply
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Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at the IPJs (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis). Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IP) to maintain hold - tests adductor pollicis muscle), hypothenar eminence wasting. N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



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Anatomy: Forearm and Hand



Question 22 of 102

A 54 year old woman presents to ED having sustained a laceration to the palm of her hand while gardening. She is unable to touch the pad of her little finger with her thumb, but sensation is intact. Which of the following nerves has most likely been injured:

a Anterior interosseous nerve

b Recurrent branch of the median nerve

c Deep branch of the ulnar nerve

d Superficial branch of the ulnar nerve

e Deep branch of the radial nerve

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Anatomy: Forearm and Hand

Question 22 of 102

A 54 year old woman presents to ED having sustained a laceration to the palm of her hand while gardening. She is unable to touch the pad of her little finger with her thumb, but sensation is intact. Which of the following nerves has most likely been injured:

a) Anterior interosseous nerve
b) **Recurrent branch of the median nerve** ✔
c) Deep branch of the ulnar nerve
d) Superficial branch of the ulnar nerve
e) Deep branch of the radial nerve

Answer

The recurrent branch of the median nerve innervates the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and has no sensory function. Damage to this nerve results in weakness of abduction, opposition and flexion of the thumb. The anterior interosseous nerve is a branch of the median nerve and innervates the deep muscles of the anterior forearm – damage to this nerve would result in weakness of thumb flexion but not opposition as described in this patient.

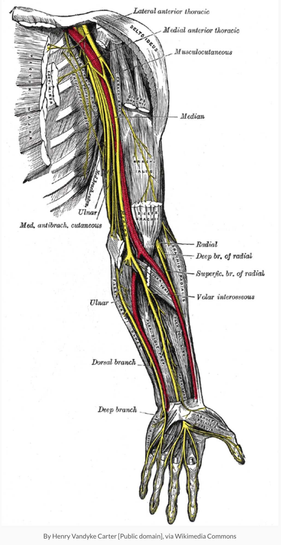
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 23 of 102

A 34 year old man presents to ED having sustained a laceration to the fingernail of his little finger whilst opening a tin. You note the laceration extends through his nailbed, and your consultant asks you to perform a ring block in order to suture the wound. Which of the following nerves would need to be anaesthetised for painless wound closure:

a Superficial branch of the ulnar nerve

b Palmar digital branch of the median nerve

c Recurrent branch of the median nerve

d Superficial branch of the radial nerve

e Palmar cutaneous branch of the ulnar nerve

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Anatomy: Forearm and Hand

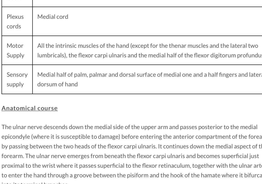
Question 23 of 102

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a) Superficial branch of the ulnar nerve ✔
b) Palmar digital branch of the median nerve
c) Recurrent branch of the median nerve
d) Superficial branch of the radial nerve
e) Palmar cutaneous branch of the ulnar nerve

Answer

The digits are supplied by four digital nerves. The palmar digital nerves innervate the palmar aspect of the digit and the nailbed, and the dorsal nerves innervate the dorsum of the digit. The common palmar digital nerves of the ulnar nerve arise from the superficial branch of the ulnar nerve, and innervate the medial one and a half fingers. The common palmar digital nerves of the median nerve innervate the lateral three and a half fingers. The superficial branch of the radial nerve supplies the dorsum of the lateral three and a half fingers. The dorsal cutaneous branch of the ulnar nerve supplies the dorsum of the medial one and a half fingers.



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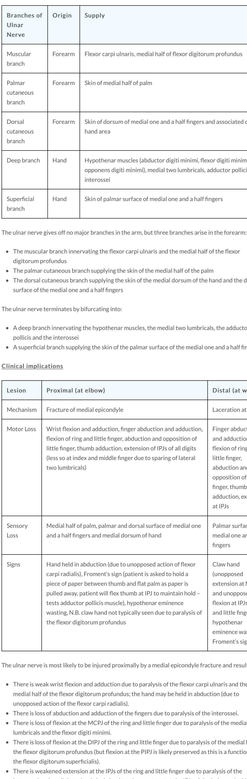
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IP/s of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IP/s
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting. N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IP/s of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IP/s of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IP/s of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IP/s (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



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Anatomy: Forearm and Hand



Question 24 of 102

A 65 year old woman presents to the ED complaining of paresthesia in the left arm. On examination you note she has no sensation over the lateral aspect of the forearm. The skin over the lateral aspect of the forearm is supplied by which of the following nerves:

a The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve

b The lateral cutaneous nerve of the forearm, branch of the radial nerve

c The lateral cutaneous nerve of the forearm, branch of the ulnar nerve

d The lateral cutaneous nerve of the forearm, branch of the median nerve

e The lateral cutaneous nerve of the forearm, from the brachial plexus

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Anatomy: Forearm and Hand

Question 24 of 102

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a)
The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve

b) The lateral cutaneous nerve of the forearm, branch of the radial nerve

c) The lateral cutaneous nerve of the forearm, branch of the ulnar nerve

d) The lateral cutaneous nerve of the forearm, branch of the median nerve

e) The lateral cutaneous nerve of the forearm, from the brachial plexus

Answer

The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

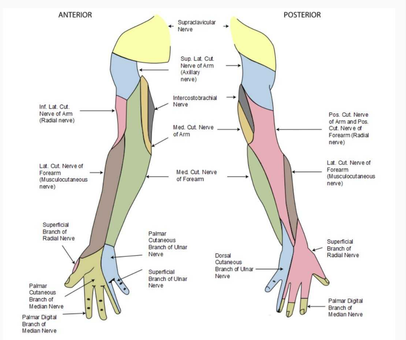
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 25 of 102

You are asked to review a 62 year old woman who presents with a numb left arm. On examination you note she lacks sensation to the skin over the medial aspect of the forearm. The skin over the medial aspect of the forearm is supplied by which of the following nerves:

a Medial cutaneous nerve of the forearm, branch of the musculocutaneous nerve

b Medial cutaneous nerve of the forearm, branch of the radial nerve

c Medial cutaneous nerve of the forearm, branch of the median nerve

d Medial cutaneous nerve of the forearm, branch of the ulnar nerve

e Medial cutaneous nerve of the forearm from the brachial plexus

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Anatomy: Forearm and Hand

Question 25 of 102

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a) Medial cutaneous nerve of the forearm, branch of the musculocutaneous nerve
b) Medial cutaneous nerve of the forearm, branch of the radial nerve
c) Medial cutaneous nerve of the forearm, branch of the median nerve
d) Medial cutaneous nerve of the forearm, branch of the ulnar nerve
e) **Medial cutaneous nerve of the forearm from the brachial plexus** ✔

Answer

The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

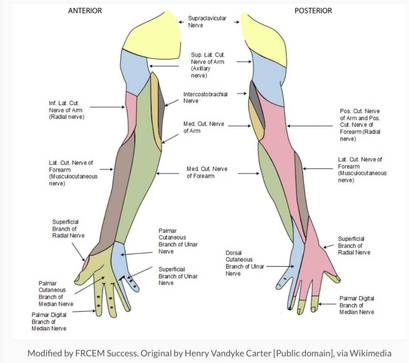
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 26 of 102

A 34 year old tree surgeon suffers a crush injury to the entire little finger. Which of the following muscles would you least expect to be affected in this injury:

a Lumbrical

b Palmar interosseous muscle

c Dorsal interosseous muscle

d Flexor digitorum profundus

e Flexor digitorum superficialis

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Anatomy: Forearm and Hand



Question 26 of 102

A 34 year old tree surgeon suffers a crush injury to the entire little finger. Which of the following muscles would you least expect to be affected in this injury:

a) Lumbrical ✘
b) Palmar interosseous muscle
c) Dorsal interosseous muscle ✔
d) Flexor digitorum profundus
e) Flexor digitorum superficialis

Answer

The dorsal interossei insert into the extensor hoods and proximal phalanges of the index, middle and ring finger, but not the little finger, which has its own abductor digiti minimi muscle, part of the hypothenar eminence.

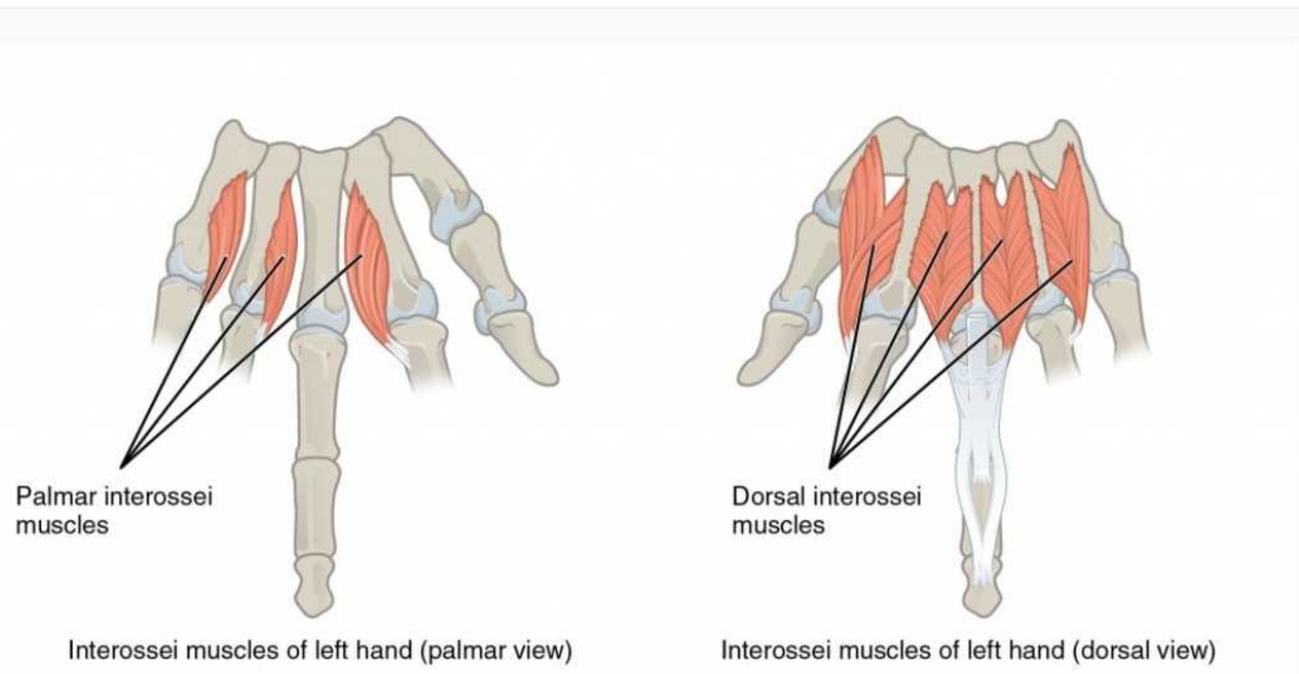
Notes

The interosseous muscles originate from and lie between the metacarpal bones. The dorsal interossei insert into the extensor hoods and proximal phalanges of the index, middle and ring finger. The palmar interossei insert into the extensor hoods of the index, ring and little finger.

The four dorsal interossei act to abduct the index, middle and ring fingers, and the three palmar interossei act to adduct the index, ring and little fingers. (DAB, PAD). Because the interosseous muscles insert into the extensor hoods, they also contribute to the complex flexion and extension movements of the interphalangeal joints of the digits.

The interosseous muscles are all innervated by the ulnar nerve.

Muscle	Action	Innervation
Dorsal interossei	Abduction of fingers at MCPJ	Ulnar nerve
Palmar interossei	Adduction of fingers at MCPJ	Ulnar nerve



Interossei muscles of left hand (palmar view) Interossei muscles of left hand (dorsal view)

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Anatomy: Forearm and Hand



Question 27 of 102

A patient presents with weakness of the left forearm and hand. You examine the strength of the muscles in the anterior forearm. The flexor carpi ulnaris tendon is attached distally to which of the following structures:

a The lunate and the triquetrum

b The pisiform, hook of hamate and 5th metacarpal

c The lunate and the hook of hamate

d The triquetrum, pisiform and 5th metacarpal

e The lunate, hook of hamate and 4th metacarpal

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Question 27 of 102

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a) The lunate and the triquetrum
b) **The pisiform, hook of hamate and 5th metacarpal** ✔
c) The lunate and the hook of hamate
d) The triquetrum, pisiform and 5th metacarpal
e) The lunate, hook of hamate and 4th metacarpal

Answer

The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

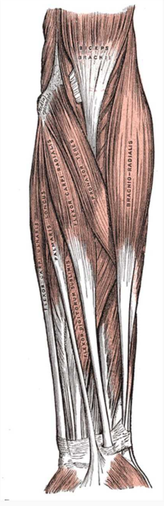
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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Anatomy: Forearm and Hand



Question 28 of 102

A 45 year old woman sustains an injury to the median nerve at the elbow after falling awkwardly. Which of the following clinical features are you least likely to see on examination:

a Weakness of pronation

b Weakness of wrist flexion

c Loss of flexion of the medial four digits.

d Loss of sensation to skin over the lateral palm and lateral three and a half digits

e Hand of Benediction appearance when the patient is asked to make a fist

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Anatomy: Forearm and Hand



Question 29 of 102

A 32 year old woman presents to ED following an injury to her right elbow. She is complaining of weak grip in her right hand. You ask her to hold onto a piece of paper with both hands as you pull it away from her. The result of the test is shown below. Which of the following nerves is most likely damaged:

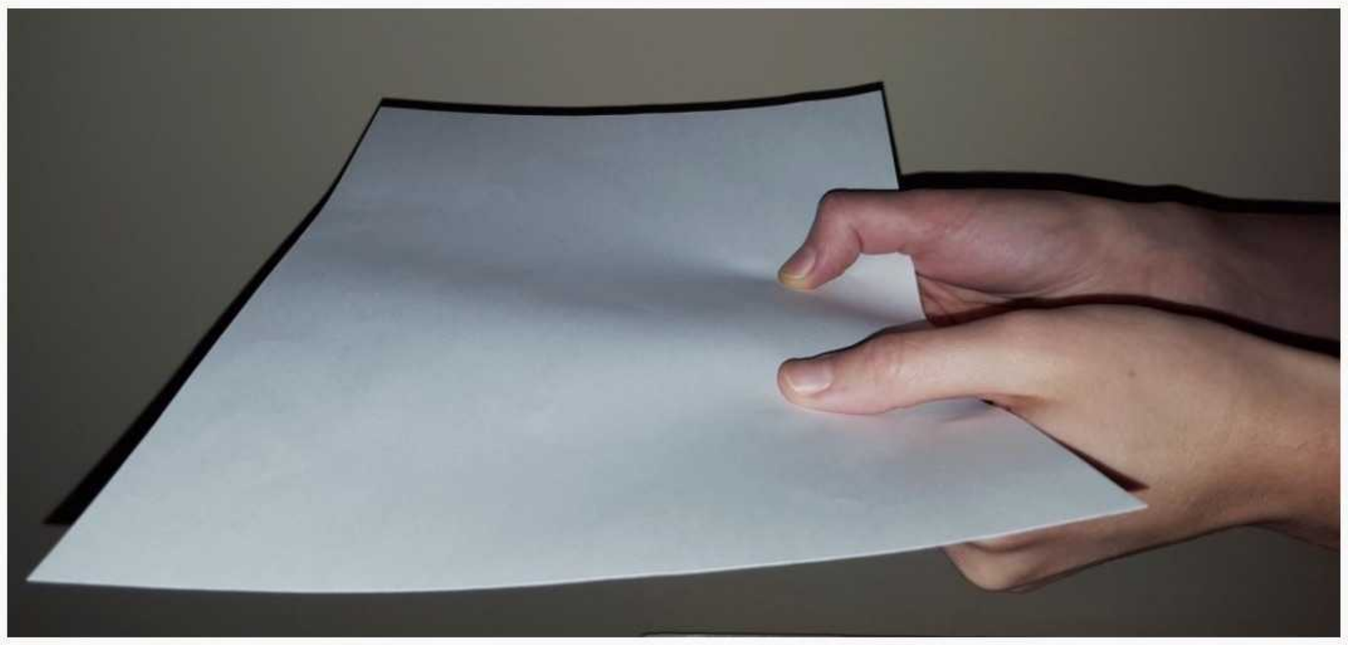


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a Axillary nerve

b Median nerve

c Musculocutaneous nerve

d Radial nerve

e Ulnar nerve

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Anatomy: Forearm and Hand

Question 29 of 102

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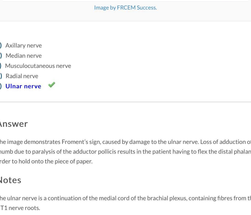


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a) Axillary nerve
b) Median nerve
c) Musculocutaneous nerve
d) Radial nerve
e) **Ulnar nerve** ✔

Answer

The image demonstrates Froment's sign, caused by damage to the ulnar nerve. Loss of adduction of the thumb due to paralysis of the adductor pollicis results in the patient having to flex the distal phalanx in order to hold onto the piece of paper.

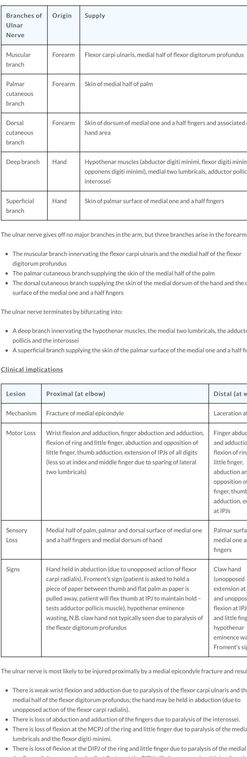
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IP2s of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IP2s
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IP2 to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IP2s of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 30 of 102

A 21 year old man presents to the ED after sustaining a penetrating knife injury to the hand. You suspect injury to the structure attached to the proximal lumbrical muscles. The lumbrical muscles originate from which of the following structures:

a The flexor retinaculum

b The tendon of the palmaris longus

c The palmar aponeurosis

d The tendons of the flexor digitorum superficialis

e The tendons of the flexor digitorum profundus

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Question 30 of 102

A 21 year old man presents to the ED after sustaining a penetrating knife injury to the hand. You suspect injury to the structure attached to the proximal lumbrical muscles. The lumbrical muscles originate from which of the following structures:

a) The flexor retinaculum
b) The tendon of the palmaris longus
c) The palmar aponeurosis
d) The tendons of the flexor digitorum superficialis
e) **The tendons of the flexor digitorum profundus** ✔

Answer

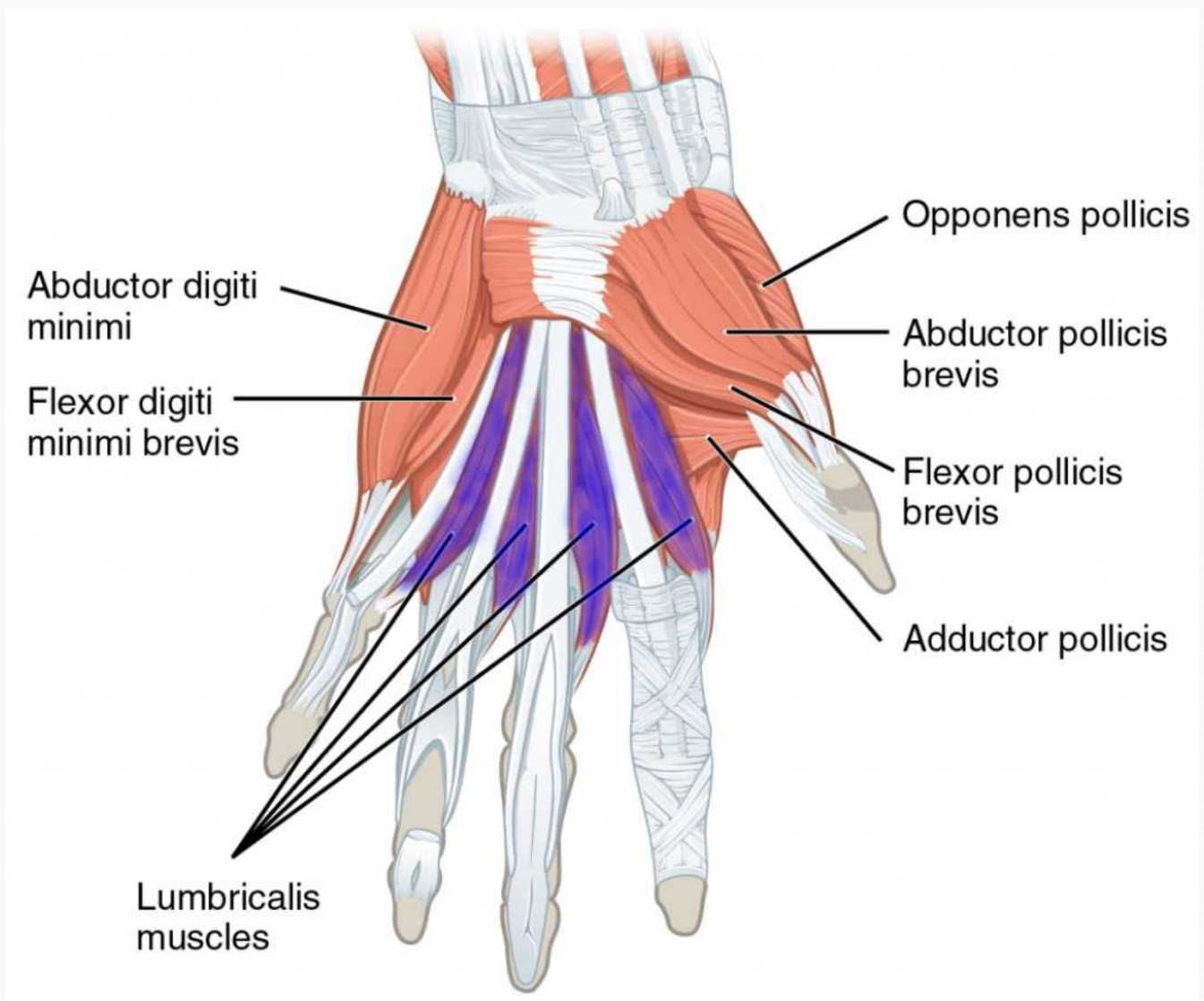
The lumbrical muscles originate from the tendons of the flexor digitorum profundus muscle.

Notes

The lumbrical muscles originate from the tendons of the flexor digitorum profundus in the palm and insert into the extensor hoods of the medial four fingers.

The lumbrical muscles act to flex these fingers at the metacarpophalangeal joints (MCPJs) and extend them at the interphalangeal joints (IPJs).

The medial two lumbricals are innervated by the ulnar nerve and the lateral two lumbricals are innervated by the median nerve.



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Anatomy: Forearm and Hand

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A 32 year old man presents to ED with a deep laceration to the proximal part of the forearm. On further assessment, when the patient is asked to make a fist, he is unable to flex the metacarpophalangeal joints or interphalangeal joints of the index and middle finger or the thumb. For the most part the ring and little fingers are intact, although you note some weakness at the proximal interphalangeal joint. There is loss of sensation over the lateral palm and the palmar surface of the lateral three and a half fingers. Which of the following nerve(s) has most likely been affected:

a) **Median nerve** ✔
b) Ulnar nerve
c) Median and ulnar nerve
d) Radial nerve
e) Median and radial nerve

Answer

In a median nerve injury affecting the extrinsic and intrinsic muscles of the hand there is:

- Weakness of flexion of the distal interphalangeal joints of the index and middle finger due to paralysis of the lateral half of the flexor digitorum profundus (the medial two digits are controlled by the medial half innervated by the ulnar nerve)
- Weakness of flexion of the metacarpophalangeal joints of the index and middle finger due to paralysis of the lateral two lumbricals (the medial two digits are controlled by the medial two lumbricals innervated by the ulnar nerve)
- Weakness of flexion of the proximal interphalangeal joints of all four fingers may be seen due to paralysis of the flexor digitorum superficialis
- Weakness of thumb flexion, abduction and opposition due to paralysis of the flexor pollicis longus and the thenar muscles
- Loss of sensation to the lateral palm and the lateral three and a half fingers

If the ulnar nerve was affected as well, all four digits would be affected.

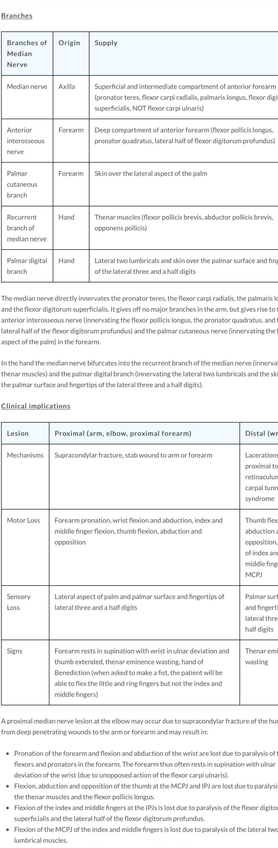
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 32 of 102

A 78 year old woman suffers a destructive injury to the anatomical snuff box region after falling on an outstretched hand. Which of the following carpal bones would you not expect to be affected in this injury:

a Scaphoid bone

b Trapezium bone

c Radial styloid process

d Trapezoid bone

e 1st metacarpal

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Anatomy: Forearm and Hand

Question 32 of 102

A 78 year old woman suffers a destructive injury to the anatomical snuff box region after falling on an outstretched hand. Which of the following carpal bones would you not expect to be affected in this injury:

a) Scaphoid bone ✗
b) Trapezium bone
c) Radial styloid process
d) Trapezoid bone ✓
e) 1st metacarpal

Answer

The trapezoid bone is not palpated in the anatomical snuffbox. The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

Notes

The anatomical snuffbox is the triangular depression formed on the posterolateral side of the dorsal wrist and 1st metacarpal by the extensor tendons passing into the thumb.

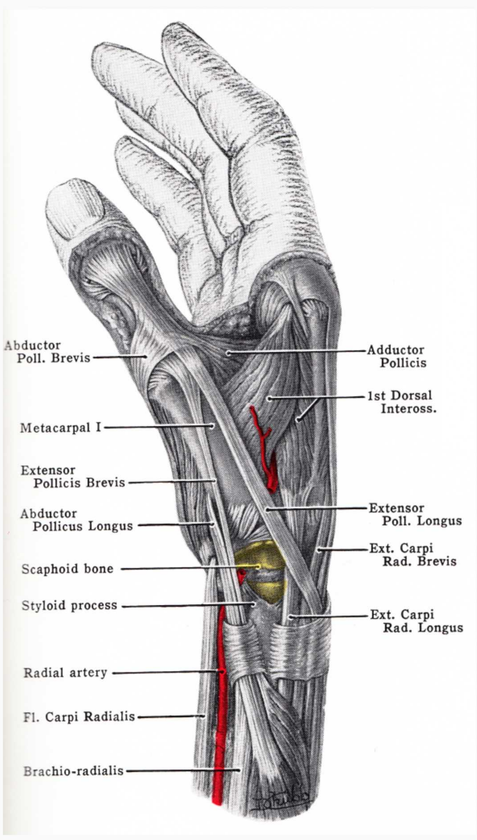
Anatomical Boundaries	Structure
Medial border	Tendon of extensor pollicis longus
Lateral border	Tendons of the abductor pollicis longus and extensor pollicis brevis
Proximal border	Radial styloid process
Distal border	1st metacarpal
Floor	Scaphoid and trapezium bones
Roof	Skin
Contents	Radial artery, terminal portion of the superficial branch of the radial nerve, cephalic vein

It is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis and medially by the tendon of the extensor pollicis longus.

The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

The radial artery crosses the floor of the anatomical snuffbox. Subcutaneously terminal parts of the superficial branch of the radial nerve and the origin of the cephalic vein pass over the anatomical snuffbox.

The anatomical snuffbox is important clinically as the scaphoid is palpable within the snuffbox; localised pain and tenderness of the anatomical snuffbox is most likely due to a scaphoid fracture.



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Anatomy: Forearm and Hand



Question 33 of 102

A 87 year old woman is brought in to the ED by her concerned family. They describe increasing swelling and tenderness of her right wrist. She is now febrile and you suspect septic arthritis. Which of the following synovial joint type best describes the wrist joint:

a Synovial plane joint

b Synovial modified hinge joint

c Synovial saddle joint

d Synovial condyloid joint

e Synovial pivot joint

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Anatomy: Forearm and Hand

Question 33 of 102

A 87 year old woman is brought in to the ED by her concerned family. They describe increasing swelling and tenderness of her right wrist. She is now febrile and you suspect septic arthritis. Which of the following synovial joint type best describes the wrist joint:

a) Synovial plane joint
b) Synovial modified hinge joint
c) Synovial saddle joint
d) **Synovial condyloid joint** ✔
e) Synovial pivot joint

Answer

The wrist joint is a synovial condyloid joint occurring between the distal end of the radius and the articular disc overlying the distal end of the ulna and the scaphoid, lunate and triquetrum.

Notes

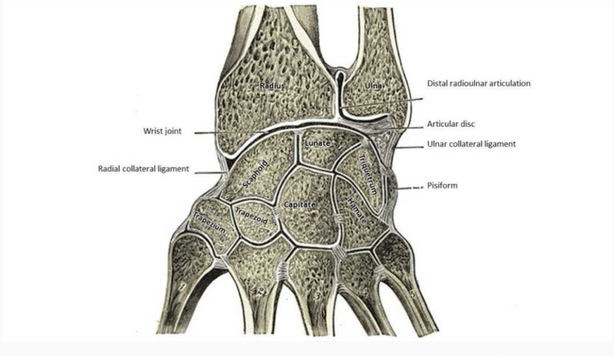
Joint	Wrist joint
Type	Synovial condyloid joint
Articulations	Distal end of the radius and articular disc with scaphoid, lunate and triquetrum
Stabilising factors	Joint capsule, palmar radiocarpal, palmar ulnocarpal and dorsal radiocarpal ligaments, radial and ulnar collateral ligaments of the wrist joint
Movements	Flexion and extension, abduction and adduction

The wrist joint is a synovial condyloid joint occurring between the distal end of the radius and the articular disc overlying the distal end of the ulna and the scaphoid, lunate and triquetrum.

The capsule of the wrist joint is reinforced by palmar radiocarpal, palmar ulnocarpal and dorsal radiocarpal ligaments. The radial and ulnar collateral ligaments of the wrist joint reinforce the medial and lateral sides of the wrist joint.

The wrist joint allows movement around two axes; the hand can be abducted and adducted, and flexed and extended at the wrist joint.

Movement	Muscles Involved
Flexion	Flexor carpi radialis, flexor carpi ulnaris, flexor digitorum profundus, flexor digitorum superficialis, palmaris longus
Extension	Extensor carpi radialis longus and brevis, extensor carpi ulnaris, extensor digitorum
Abduction	Flexor carpi radialis, extensor carpi radialis longus and brevis
Adduction	Flexor carpi ulnaris, extensor carpi ulnaris



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Anatomy: Forearm and Hand



Question 34 of 102

A 24 year old butcher has sustained a deep laceration to the distal crease of the wrist where he has cut through the ulnar nerve. Which of the following clinical findings would you most expect to see on examination:

a Loss of sensation to the dorsum of the medial hand

b Weakness of flexion at the proximal interphalangeal joints of all four fingers

c Loss of opposition of the thumb

d Weakness of extension at the interphalangeal joints of all four fingers

e Weakness of extension of the thumb

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A 24 year old butcher has sustained a deep laceration to the distal crease of the wrist where he has cut through the ulnar nerve. Which of the following clinical findings would you most expect to see on examination:

a) **Loss of sensation to the dorsum of the medial hand** ✗
b) Weakness of flexion at the proximal interphalangeal joints of all four fingers
c) Loss of opposition of the thumb
d) Weakness of extension at the interphalangeal joints of all four fingers ✓
e) Weakness of extension of the thumb

Answer

The ulnar nerve innervates the interossei and the medial two lumbricals, which are important muscles in extension of the fingers at the interphalangeal joints. Flexion at the proximal interphalangeal joints is produced primarily by the flexor digitorum superficialis, innervated by the median nerve. Sensation to the dorsum of the medial hand is innervated by the dorsal cutaneous branch of the ulnar nerve which arises in the forearm, proximal to the site of laceration. Extension of the the thumb is primarily a function of the radial nerve, and opposition of the thumb, the median nerve.

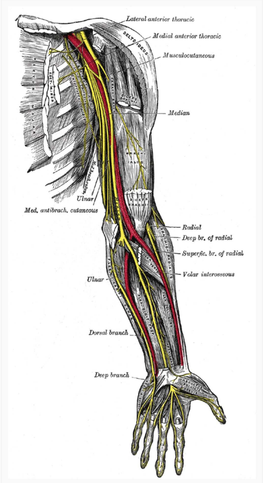
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

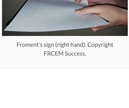
Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



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Anatomy: Forearm and Hand

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A 49 year old patient sustains a crush injury to his left hand. You are attempting to assess which muscle tendons may be affected based on their distal attachment. Regarding the distal attachments of the anterior forearm muscles, which of the following is paired CORRECTLY:

a) Flexor pollicis longus – base of proximal phalanx of thumb
b) **Flexor digitorum profundus – distal phalanges of digits 2 – 5** ✔
c) Flexor digitorum superficialis – proximal phalanges of digits 2 – 5
d) Flexor carpi ulnaris – hook of hamate and 4th metacarpal
e) Flexor carpi radialis – base of 1st metacarpal

Answer

The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers. The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb. The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers. The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal. The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

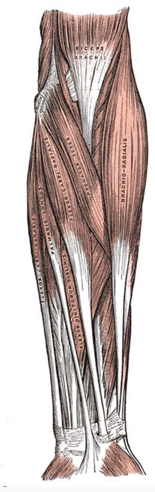
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

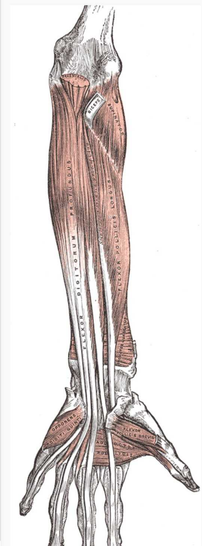
The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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Anatomy: Forearm and Hand



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A 32 year old woman sustains an injury to the ulnar nerve at the elbow after sustaining a fracture of the medial epicondyle. Which of the following clinical findings would you least expect to see on examination:

a Weakness of wrist flexion

b Weakness of abduction of the fingers

c Weakness of adduction of the fingers

d Weakness of adduction of the thumb

e Weakness of abduction of the thumb

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a) Weakness of wrist flexion
b) Weakness of abduction of the fingers
c) Weakness of adduction of the fingers
d) Weakness of adduction of the thumb
e) **Weakness of abduction of the thumb** ✔

Answer

Abduction of the thumb is mediated by the abductor pollicis longus and brevis innervated by the radial nerve and the median nerve respectively.

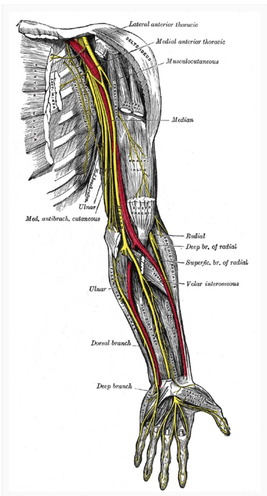
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



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Anatomy: Forearm and Hand



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A 54 year old carpenter has sustained a laceration to his left hand with a stanley knife. He is unable to flex the proximal interphalangeal joint of his middle finger which is held in extension. Which of the following structures has most likely been injured:

a Tendon of the flexor digitorum superficialis

b Tendon of the flexor digitorum profundus

c Lumbrical muscle

d Interosseous muscle

e Digital branch of the median nerve

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Anatomy: Forearm and Hand

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A 54 year old carpenter has sustained a laceration to his left hand with a stanley knife. He is unable to flex the proximal interphalangeal joint of his middle finger which is held in extension. Which of the following structures has most likely been injured:

a) **Tendon of the flexor digitorum superficialis** ✔
b) Tendon of the flexor digitorum profundus
c) Lumbrical muscle
d) Interosseous muscle
e) Digital branch of the median nerve

Answer

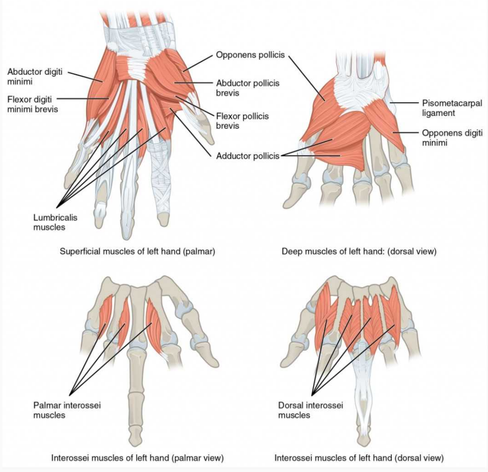
The flexor digitorum superficialis is primarily responsible for flexion at the proximal interphalangeal joint and thus separation of this tendon from its attachment on the middle phalanx of the finger will result in loss of this movement. The flexor digitorum profundus flexes the distal interphalangeal joint. Flexion at the metacarpophalangeal joint is primarily produced by the lumbrical muscles with assistance from the interossei and the flexor digitorum profundus and superficialis. Abduction and adduction of the fingers at the metacarpophalangeal joint is produced by the interossei.

Notes

Hand movements are complex. The table below shows an overview of hand and thumb movements and the main muscles bringing about these movements.

Hand movements	Primary muscle (assisting muscles)
Flexion of MCPJ of digits 2 – 5	Lumbricals (flexor digitorum superficialis, flexor digitorum profundus, flexor digiti minimi, interossei)
Flexion of PIPJ of digits 2 – 5	Flexor digitorum superficialis (flexor digitorum profundus)
Flexion of DIPJ of digits 2 – 5	Flexor digitorum profundus
Extension of MCPJ of digits 2 – 5	Extensor digitorum, extensor indicis, extensor digiti minimi
Extension of PIPJ and DIPJ of digits 2 – 5	Lumbricals and interossei (extensor digitorum)
Adduction of digits 2 – 5	Palmar interossei
Abduction of digits 2 – 4	Dorsal interossei
Abduction of little finger	Abductor digiti minimi
Opposition of little finger	Opponens digiti minimi

Thumb movements	Primary muscle(s)
Flexion of thumb at MCPJ	Flexor pollicis longus and brevis
Flexion of thumb at IPJ	Flexor pollicis longus
Extension of thumb at CMCJ and MCPJ	Extensor pollicis longus and brevis
Extension of thumb at IPJ	Extensor pollicis longus
Abduction of thumb	Abductor pollicis longus and brevis
Adduction of thumb	Adductor pollicis
Opposition of thumb	Opponens pollicis



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A 27 year old rugby player is brought to the ED complaining of neck pain after a scrum collapsed. On examination he is tender over C7 and T1. The C8 dermatome is best tested at which of the following landmarks:

a Lateral antecubital fossa

b Medial antecubital fossa

c Dorsum of middle finger

d Dorsum of little finger

e Dorsum of thumb

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b) Medial antecubital fossa
c) Dorsum of middle finger
d) **Dorsum of little finger** ✔
e) Dorsum of thumb

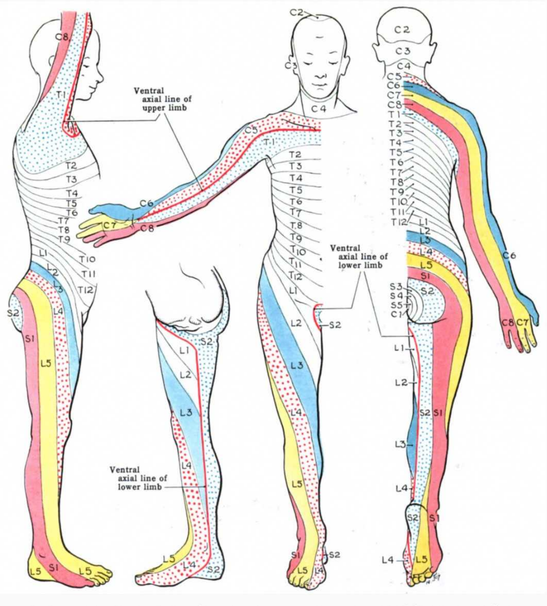
Answer

The C8 dermatome is best tested on the dorsal surface of the proximal phalanx of the little finger.

Notes

Dermatome	Landmark
C2	Occipital Protuberance
C3	Supraclavicular Fossa
C4	Acromioclavicular Joint
C5	Lateral Antecubital Fossa
C6	Thumb
C7	Middle Finger
C8	Little Finger
T1	Medial Antecubital Fossa
T2	Apex of Axilla

- The C2 dermatome is best tested at least one cm lateral to the occipital protuberance at the base of the skull. Alternately, it can be located at least 3 cm behind the ear.
- The C3 dermatome is best tested in the supraclavicular fossa, at the midclavicular line.
- The C4 dermatome is best tested over the acromioclavicular joint.
- The C5 dermatome is best tested on the lateral (radial) side of the antecubital fossa just proximal to the elbow.
- The C6 dermatome is best tested on the dorsal surface of the proximal phalanx of the thumb.
- The C7 dermatome is best tested on the dorsal surface of the proximal phalanx of the middle finger.
- The C8 dermatome is best tested on the dorsal surface of the proximal phalanx of the little finger.
- The T1 dermatome is best tested on the medial (ulnar) side of the antecubital fossa, just proximal to the medial epicondyle of the humerus.
- The T2 dermatome is best tested at the apex of the axilla.



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A patient presents with pain in the wrist and a tingling in the hand. On examination Tinel's test is positive and you diagnose carpal tunnel syndrome. Regarding the carpal tunnel, which of the following statements is INCORRECT:

a The tendons of the flexor digitorum profundus, flexor digitorum superficialis and flexor pollicis longus lie within a single synovial sheath.

b The median nerve lies anterior to the tendons in the carpal tunnel.

c The ulnar nerve and ulnar artery pass over, not through, the carpal tunnel.

d The floor of the carpal tunnel is formed medially by the pisiform and hook of the hamate.

e The flexor retinaculum forms the roof of the carpal tunnel.

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a) ✔
The tendons of the flexor digitorum profundus, flexor digitorum superficialis and flexor pollicis longus lie within a single synovial sheath.

b) **The median nerve lies anterior to the tendons in the carpal tunnel.** ✖

c) The ulnar nerve and ulnar artery pass over, not through, the carpal tunnel.

d) The floor of the carpal tunnel is formed medially by the pisiform and hook of the hamate.

e) The flexor retinaculum forms the roof of the carpal tunnel.

Answer

Free movement of the tendons in the carpal tunnel is facilitated by synovial sheaths, which surround the tendons. All of the tendons of the FDP and FDS are contained within a single synovial sheath with a separate sheath enclosing the tendon of the FPL.

Notes

Anatomical Boundaries	Structure
Roof	Flexor retinaculum
Carpal arch	Pisiform and hook of the hamate medially, tubercles of the scaphoid and trapezium laterally
Contents	Four tendons of flexor digitorum profundus, four tendons of flexor digitorum superficialis, tendon of flexor pollicis longus, median nerve

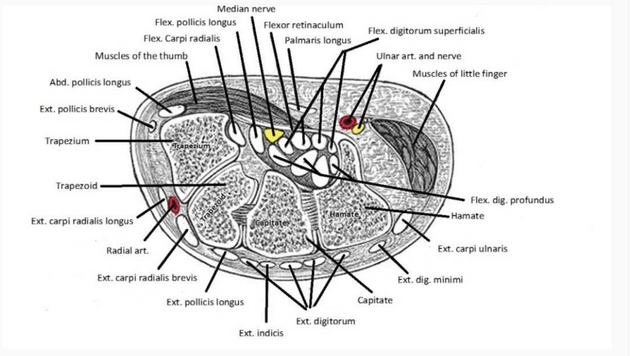
The carpal tunnel is formed by a deep carpal arch and a superficial flexor retinaculum. The base of the carpal tunnel is formed medially by the pisiform and the hook of the hamate and laterally by the tubercles of the scaphoid and trapezium. The flexor retinaculum is a thickened band of fibrous connective tissue on the volar aspect of the hand, which bridges the gap between these carpal bones and forms the roof of the carpal tunnel.

The following structures pass through the carpal tunnel:

- the four tendons of the flexor digitorum profundus (FDP)
- the four tendons of the flexor digitorum superficialis (FDS)
- the tendon of the flexor pollicis longus (FPL)
- the median nerve.

Free movement of the tendons in the carpal tunnel is facilitated by synovial sheaths, which surround the tendons. All of the tendons of the FDP and FDS are contained within a single synovial sheath with a separate sheath enclosing the tendon of the FPL. The median nerve lies anterior to the tendons in the carpal tunnel.

Carpal tunnel syndrome is caused by compression of the median nerve within the carpal tunnel.



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A 34 year old patient presents to ED having sustained an injury to her right hand whilst playing cricket. She is unable to fully straighten her right middle finger as the distal phalanx remains flexed. A picture of her hand is shown below. Which of the following structures within the digit was most likely injured:



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a Superficial branch of radial nerve

b Insertion of central slip of extensor digitorum tendon

c Insertion of terminal extensor digitorum tendon

d Insertion of flexor digitorum profundus tendon

e Palmar digital branch of median nerve

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A 34 year old patient presents to ED having sustained an injury to her right hand whilst playing cricket. She is unable to fully straighten her right middle finger as the distal phalanx remains flexed. A picture of her hand is shown below. Which of the following structures within the digit was most likely injured:



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a) Superficial branch of radial nerve
b) Insertion of central slip of extensor digitorum tendon
c) **Insertion of terminal extensor digitorum tendon** ✔
d) Insertion of flexor digitorum profundus tendon
e) Palmar digital branch of median nerve

Answer

Damage to the insertion of the terminal extensor digitorum tendon would result in loss of extension at the distal interphalangeal joint causing a fixed flexion deformity, called the Mallet deformity.

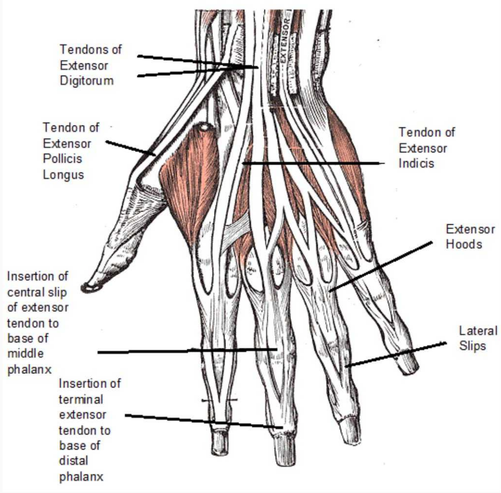
Notes

The tendons of the extensor digitorum (and extensor pollicis longus) pass onto the dorsal aspect of the digits and expand over the proximal phalanges to form complex extensor hoods. The central slip inserts into the base of the middle phalanx, and distally the tendon inserts into the distal phalanx of each digit.

Division of the central slip of the extensor tendon will result in the Boutonniere deformity, with loss of extension of the proximal interphalangeal joint and loss of flexion of the distal interphalangeal joint. The middle phalanx is held in forced flexion, with hyperextension of the distal phalanx.

Division of the terminal extensor tendon will result in the Mallet deformity, with loss of extension at the distal interphalangeal joint; the distal phalanx is held in forced flexion due to unopposed action of the flexor digitorum profundus muscle.

Structure	Terminal extensor tendon	Central slip of extensor tendon
Attachment	Distal phalanx	Middle phalanx
Movements affected in injury	Loss of extension at distal interphalangeal joint	Loss of extension at proximal interphalangeal joint and flexion at distal interphalangeal joint
Deformity in injury	Mallet deformity: Distal phalanx held in fixed flexion	Boutonniere deformity: Middle phalanx held in fixed flexion with hyperextension of distal phalanx



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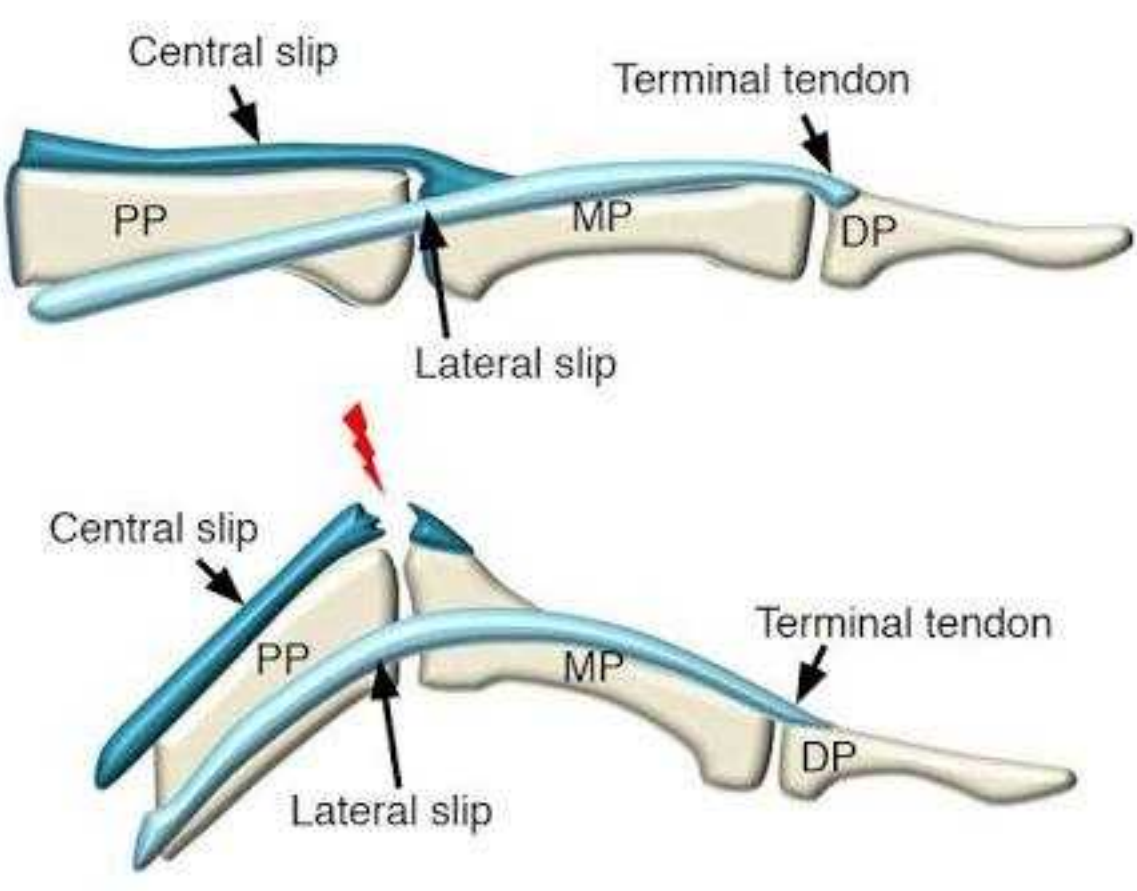
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Central slip
Terminal tendon
PP
MP
DP
Lateral slip
Central slip
Terminal tendon
PP
MP
DP
Lateral slip

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A 58 year old man sustains an injury to the ulnar nerve and complains of sensory loss. Which of the following areas of skin would you least expect to be affected:

a) Medial half of palm
b) Dorsal surface of medial one and a half digits
c) Palmar surface of medial one and a half digits
d) Dorsal and palmar surface of little finger
e) **Medial forearm** ✔

Answer

The ulnar nerve supplies sensation to the medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand.

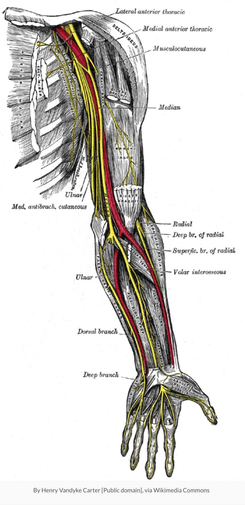
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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You are performing a neurological examination on a patient who complains of weakness of the left arm. You note muscle wasting in the posterior forearm. The muscles of the posterior compartment of the forearm are all innervated by which of the following nerves:

a Axillary nerve

b Musculocutaneous nerve

c Radial nerve

d Median nerve

e Ulnar nerve

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Anatomy: Forearm and Hand

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a) Axillary nerve
b) Musculocutaneous nerve
c) **Radial nerve** ✔
d) Median nerve
e) Ulnar nerve

Answer

The muscles of the posterior forearm are all innervated by the radial nerve.

Notes

The muscles of the posterior forearm are all innervated by the radial nerve.

The posterior forearm is divided into the superficial and deep groups:

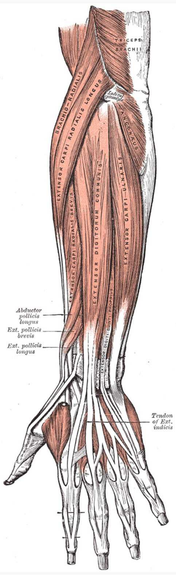
- The superficial group is made up of the brachioradialis, the extensor carpi radialis longus and brevis, the extensor digitorum, the extensor digiti mini, the anconeus and the extensor carpi ulnaris.
- The deep group is made up of the supinator, the abductor pollicis longus, the extensor pollicis longus and brevis and the extensor indicis.

Muscle	Action	Innervation
Brachioradialis	Flexion of elbow	Radial nerve
Extensor carpi radialis longus	Extension and abduction of wrist	Radial nerve
Extensor carpi radialis brevis	Extension and abduction of wrist	Radial nerve
Extensor digitorum	Extension of all four fingers, extension of wrist	Radial nerve
Extensor digiti minimi	Extension of little finger	Radial nerve
Extensor carpi ulnaris	Extension and adduction of wrist	Radial nerve
Supinator	Supination of forearm	Radial nerve
Abductor pollicis longus	Abduction and extension of thumb	Radial nerve
Extensor pollicis longus	Extension of thumb (CMCJ, MCPJ, IPJ)	Radial nerve
Extensor pollicis brevis	Extension of thumb (CMCJ and MCPJ)	Radial nerve
Extensor indicis	Extension of index finger	Radial nerve

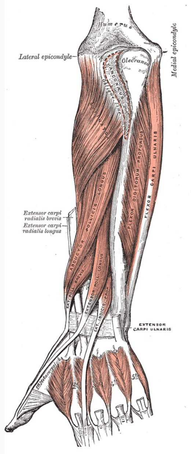
A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The abductor pollicis longus is attached distally to the lateral side of base of the 1st metacarpal.
- The extensor pollicis brevis is attached to the proximal phalanx of the thumb and the extensor pollicis longus is attached to the distal phalanx of the thumb.
- The extensor carpi radialis longus is attached to the base of the 2nd metacarpal and the extensor carpi radialis brevis is attached to the bases of the 2nd and 3rd metacarpals.
- The extensor digitorum is attached to the base of the middle and distal phalanges of digits 2 – 5 via extensor hoods.
- The extensor carpi ulnaris is attached to the base of the 5th metacarpal.
- The extensor digiti minimi is attached to the base of the 5th metacarpal.
- The extensor indicis is attached to the extensor hood of the index finger.

Muscle tendon	Distal attachment
Extensor carpi radialis longus	Dorsal surface of base of 2nd metacarpal
Extensor carpi radialis brevis	Dorsal surface of base of 2nd and 3rd metacarpal
Extensor digitorum	Dorsal aspects of bases of middle and distal phalanges of all four fingers via extensor hoods
Extensor carpi ulnaris	Tubercle on base of medial 5th metacarpal
Abductor pollicis longus	Lateral side of base of 1st metacarpal
Extensor pollicis longus	Dorsal surface of base of distal phalanx of thumb
Extensor pollicis brevis	Dorsal surface of base of proximal phalanx of thumb
Extensor indicis	Extensor hood of index finger



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A 29 year old woman is brought to the ED after concerns were raised for her welfare by a neighbour. She has a deep laceration to the anterior aspect of the right wrist. You are concerned about an injury to the underlying structures including the flexor retinaculum. The flexor retinaculum is attached medially to which of the following structures:

a Triquetrum and pisiform

b Lunate and triquetrum

c Lunate and hook of the hamate

d Pisiform and hook of the hamate

e Ulna, lunate and triquetrum

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Anatomy: Forearm and Hand

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A 29 year old woman is brought to the ED after concerns were raised for her welfare by a neighbour. She has a deep laceration to the anterior aspect of the right wrist. You are concerned about an injury to the underlying structures including the flexor retinaculum. The flexor retinaculum is attached medially to which of the following structures:

a) Triquetrum and pisiform
b) Lunate and triquetrum
c) Lunate and hook of the hamate
d) **Pisiform and hook of the hamate** ✔
e) Ulna, lunate and triquetrum

Answer

The flexor retinaculum is attached medially to the pisiform and the hook of the hamate.

Notes

The flexor retinaculum (transverse carpal ligament) is a thickened band of fibrous connective tissue on the volar aspect of the hand which forms the roof of the carpal tunnel. The flexor retinaculum holds the flexor tendons in place at the wrist and prevents them from bowstringing.

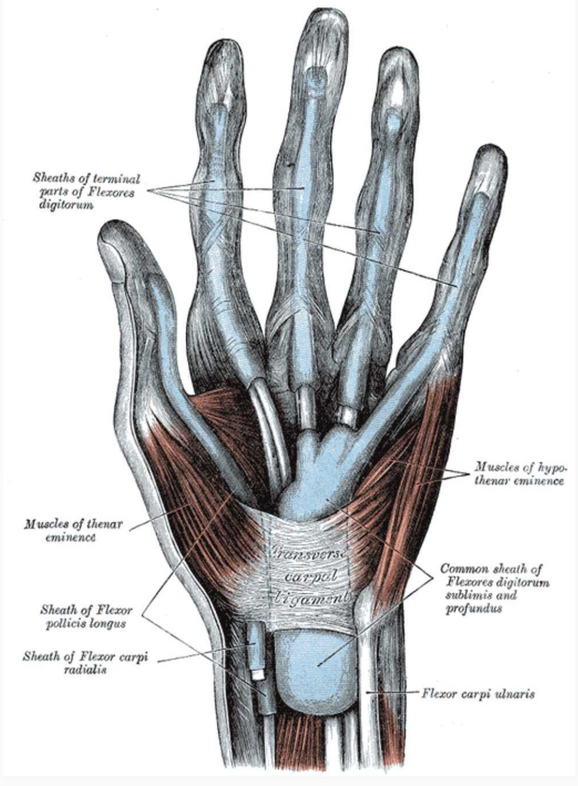
It is attached laterally to the scaphoid and trapezium and medially to the pisiform and the hook of the hamate.

The thenar and hypothenar muscles arise from the flexor retinaculum.

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

The flexor carpi radialis tendon passes through the lateral aspect of the flexor retinaculum into the hand.

The four tendons of the flexor digitorum profundus, the four tendons of the flexor digitorum superficialis, the tendon of the flexor pollicis longus and the median nerve pass into the hand posterior to the flexor retinaculum, within the carpal tunnel.



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Question 44 of 102

You have been asked to review a 43 year old man who presents with weakness to the right arm after falling. You perform a neurological examination of the upper limbs, including testing the strength of the upper limb muscles. Which of the following muscles is innervated by the median nerve:

a Interossei muscles

b Adductor pollicis

c Flexor carpi ulnaris

d Flexor carpi radialis

e Medial two lumbricals

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Question 44 of 102

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a) Interossei muscles
b) Adductor pollicis
c) Flexor carpi ulnaris
d) **Flexor carpi radialis** ✔
e) Medial two lumbricals

Answer

The flexor carpi radialis is innervated by the median nerve. The adductor pollicis, flexor carpi ulnaris, medial two lumbricals and interossei muscles are innervated by the ulnar nerve.

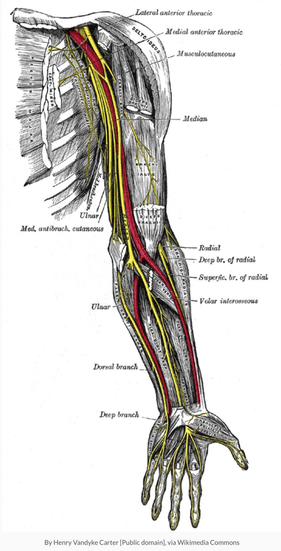
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 45 of 102

A 29 year old fell heavily while base-jumping and presents to ED with a painful right arm. X-ray shows a fracture of the medial epicondyle. Which of the following nerves is most likely damaged in this type of injury:

a Median nerve

b Radial nerve

c Musculocutaneous nerve

d Ulnar nerve

e Axillary nerve

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Question 45 of 102

A 29 year old fell heavily while base-jumping and presents to ED with a painful right arm. X-ray shows a fracture of the medial epicondyle. Which of the following nerves is most likely damaged in this type of injury:

a) Median nerve
b) Radial nerve
c) Musculocutaneous nerve
d) **Ulnar nerve** ✔
e) Axillary nerve

Answer

The ulnar nerve is most susceptible in an fracture of the medial epicondyle.

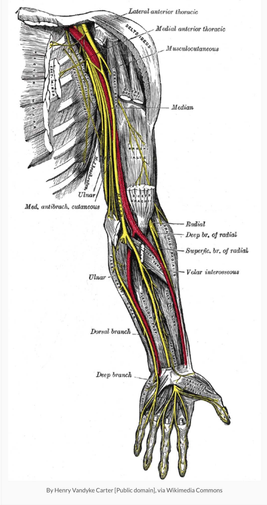
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 46 of 102

A 16 year old girl presents complaining of weakness of her left hand following an injury to her left arm. On examination she has weakness of flexion of the metacarpophalangeal joint of the ring finger, and inability to adduct that same finger. Which of the following muscles is most likely affected:

a Flexor pollicis profundus

b Flexor pollicis superficialis

c Lumbrical

d Dorsal interosseous

e Palmar interosseus

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a) Flexor pollicis profundus
b) Flexor pollicis superficialis
c) Lumbrical
d) Dorsal interosseous
e) **Palmar interosseus** ✔

Answer

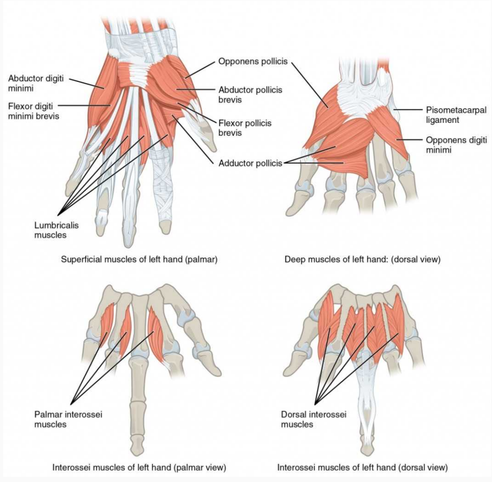
The interossei muscles assist the lumbricals with flexion of the fingers at the metacarpophalangeal joints and extension at the interphalangeal joints. The palmar interossei cause adduction of the fingers and the dorsal interossei cause abduction of the fingers. The flexor digitorum profundus and superficialis are involved in flexion at the metacarpophalangeal joint but have no function in adduction of the fingers.

Notes

Hand movements are complex. The table below shows an overview of hand and thumb movements and the main muscles bringing about these movements.

Hand movements	Primary muscle (assisting muscles)
Flexion of MCPJ of digits 2 – 5	Lumbricals (flexor digitorum superficialis, flexor digitorum profundus, flexor digiti minimi, interossei)
Flexion of PIPJ of digits 2 – 5	Flexor digitorum superficialis (flexor digitorum profundus)
Flexion of DIPJ of digits 2 – 5	Flexor digitorum profundus
Extension of MCPJ of digits 2 – 5	Extensor digitorum, extensor indicis, extensor digiti minimi
Extension of PIPJ and DIPJ of digits 2 – 5	Lumbricals and interossei (extensor digitorum)
Adduction of digits 2 – 5	Palmar interossei
Abduction of digits 2 – 4	Dorsal interossei
Abduction of little finger	Abductor digiti minimi
Opposition of little finger	Opponens digiti minimi

Thumb movements	Primary muscle(s)
Flexion of thumb at MCPJ	Flexor pollicis longus and brevis
Flexion of thumb at IPJ	Flexor pollicis longus
Extension of thumb at CMCJ and MCPJ	Extensor pollicis longus and brevis
Extension of thumb at IPJ	Extensor pollicis longus
Abduction of thumb	Abductor pollicis longus and brevis
Adduction of thumb	Adductor pollicis
Opposition of thumb	Opponens pollicis



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A 26 year old woman presents to ED having sustained a deep laceration to the dorsum of her ring finger whilst cooking. Her proximal interphalangeal joint is fixed in flexion and the distal interphalangeal joint is hyperextended. Which of the following structures in the digit has most likely been injured:

a Terminal insertion of the extensor tendon

b Superficial branch of the radial nerve

c Insertion of the flexor digitorum profundus

d Insertion of the flexor digitorum superficialis

e Insertion of the central slip of the extensor tendon

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Question 47 of 102

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a) Terminal insertion of the extensor tendon
b) Superficial branch of the radial nerve
c) Insertion of the flexor digitorum profundus
d) Insertion of the flexor digitorum superficialis
e) **Insertion of the central slip of the extensor tendon** ✔

Answer

Damage to the central slip of the extensor digitorum tendon would result in loss of extension at the proximal interphalangeal joint resulting in a fixed flexion deformity of this joint, and hyperextension of the distal interphalangeal joint due to a loss of balancing forces. This is called the Boutonniere deformity.

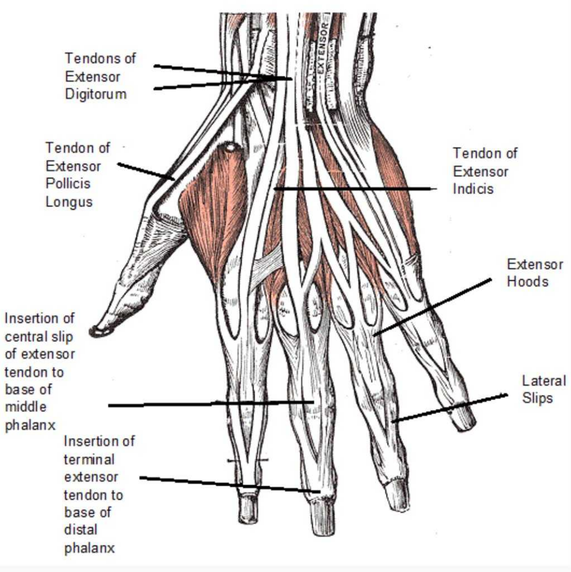
Notes

The tendons of the extensor digitorum (and extensor pollicis longus) pass onto the dorsal aspect of the digits and expand over the proximal phalanges to form complex extensor hoods. The central slip inserts into the base of the middle phalanx, and distally the tendon inserts into the distal phalanx of each digit.

Division of the central slip of the extensor tendon will result in the Boutonniere deformity, with loss of extension of the proximal interphalangeal joint and loss of flexion of the distal interphalangeal joint. The middle phalanx is held in forced flexion, with hyperextension of the distal phalanx.

Division of the terminal extensor tendon will result in the Mallet deformity, with loss of extension at the distal interphalangeal joint as in this case; the distal phalanx is held in forced flexion due to unopposed action of the flexor digitorum profundus muscle.

Structure	Terminal extensor tendon	Central slip of extensor tendon
Attachment	Distal phalanx	Middle phalanx
Movements affected in injury	Loss of extension at distal interphalangeal joint	Loss of extension at proximal interphalangeal joint and flexion at distal interphalangeal joint
Deformity in injury	Mallet deformity: Distal phalanx held in fixed flexion	Boutonniere deformity: Middle phalanx held in fixed flexion with hyperextension of distal phalanx



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A 21 year old presents to ED with an injury to his left arm after falling from a skateboard. Imaging shows a supracondylar fracture. Which nerve is most likely damaged in this type of injury:

a Radial nerve

b Ulnar nerve

c Median nerve

d Musculocutaneous nerve

e Axillary nerve

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a) Radial nerve
b) Ulnar nerve
c) **Median nerve** ✔
d) Musculocutaneous nerve
e) Axillary nerve

Answer

A supracondylar fracture most commonly results in injury to the median nerve. The axillary nerve may be damaged in a surgical neck of humerus fracture. The radial nerve may be damaged in a midshaft humerus fracture. The ulnar nerve may be damaged in a medial epicondylar fracture.

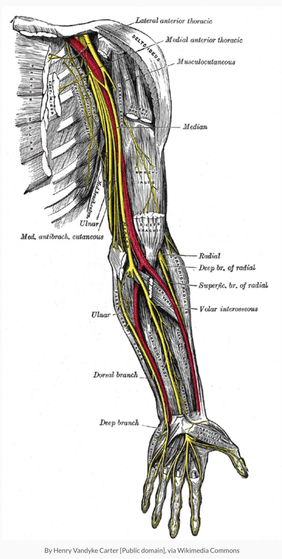
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 49 of 102

You have been asked to review a 45 year old gardener who has sustained a laceration to the dorsal surface of their wrist. You are concerned about the possibility of injury to underlying structures. The extensor retinaculum is attached to which of the following structures:

a The scaphoid laterally and the pisiform and triquetrum medially

b The radius laterally and the ulna medially

c The radius laterally and the pisiform and triquetrum medially

d The scaphoid laterally and the ulna medially

e The radius laterally and the lunate and triquetrum medially

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Question 49 of 102

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a) The scaphoid laterally and the pisiform and triquetrum medially
b) The radius laterally and the ulna medially
c) **The radius laterally and the pisiform and triquetrum medially** ✔
d) The scaphoid laterally and the ulna medially
e) The radius laterally and the lunate and triquetrum medially

Answer

The extensor retinaculum is attached laterally to the anterolateral radius above the styloid process and medially to the pisiform and triquetrum bones.

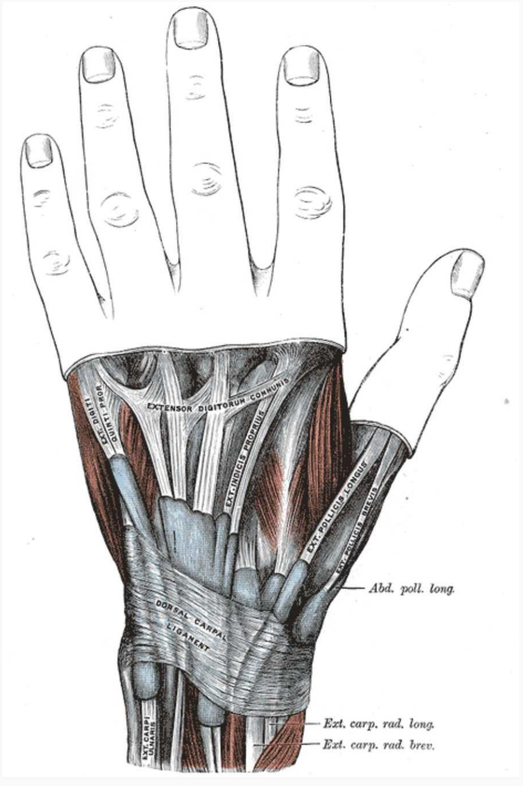
Notes

The extensor retinaculum (dorsal carpal ligament) lies obliquely across the extensor surface of the wrist joint, and holds the extensor tendons in place during movement of the wrist.

It is attached laterally to the anterolateral radius above the styloid process and medially to the pisiform and triquetrum bones. It does NOT attach to the ulna.

The extensor tendons pass through the extensor tunnel, deep to the extensor retinaculum, in six compartments lined by synovial sheaths:

- The tendons of the extensor digitorum and extensor indicis share a synovial sheath on the posterior surface of the wrist
- The tendons of the extensor carpi ulnaris and extensor digiti minimi have separate sheaths on the medial side of the wrist
- The tendons of the abductor pollicis longus and extensor pollicis brevis, the extensor carpi radialis longus and extensor carpi radialis brevis and the extensor pollicis longus have three separate sheaths on the lateral side of the wrist



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Question 50 of 102

A 54 year old patient presents to ED complaining of weakness in her right hand. She has recently undergone an endoscopic nerve release for carpal tunnel syndrome but is now complaining of a severe weakness of her thumb with loss of thumb opposition. Sensation is normal. Which of the following nerves was likely affected in the surgical procedure.

a Anterior interosseous nerve

b Recurrent branch of the median nerve

c Superficial branch of the ulnar nerve

d Deep branch of the ulnar nerve

e Palmar digital branch of the median nerve

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a) Anterior interosseous nerve
b) **Recurrent branch of the median nerve** ✔
c) Superficial branch of the ulnar nerve
d) Deep branch of the ulnar nerve
e) Palmar digital branch of the median nerve

Answer

The recurrent branch of the median nerve has likely been affected, which innervates the thenar muscles, causing weakness of thumb flexion, abduction and opposition, but has no cutaneous innervation.

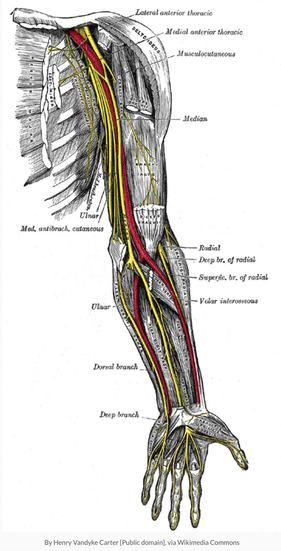
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
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Anatomy: Forearm and Hand



Question 51 of 102

A 43 year old man sustains an injury to the proximal ulnar nerve after falling through a greenhouse door. Which of the following muscles would you not expect to be affected:

a Opponens digiti minimi

b Abductor digiti minimi

c Flexor digiti minimi

d Extensor digiti minimi

e Flexor carpi ulnaris

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Question 51 of 102

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b) Abductor digiti minimi
c) Flexor digiti minimi
d) **Extensor digiti minimi** ✔
e) Flexor carpi ulnaris

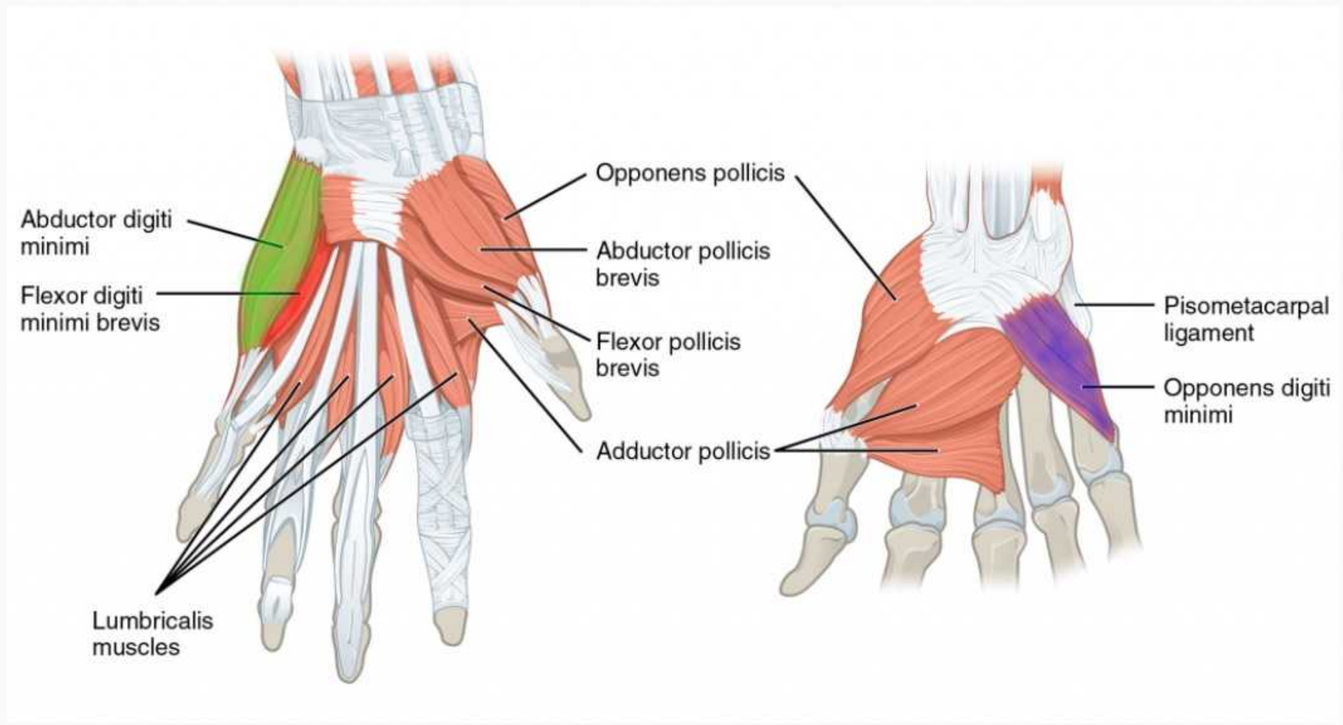
Answer

The hypothenar muscles (opponens digiti minimi, abductor digiti minimi and flexor digiti minimi) are all innervated by the ulnar nerve. The flexor carpi ulnaris in the anterior forearm is also innervated by the ulnar nerve. The extensor digiti minimi in the posterior forearm is innervated by the radial nerve.

Notes

The hypothenar muscles are the opponens digiti minimi, the abductor digiti minimi and the flexor digiti minimi, all innervated by the ulnar nerve.

Muscle	Action	Innervation
Opponens digiti minimi (blue)	Laterally rotates little finger	Ulnar nerve
Abductor digiti minimi (green)	Abducts little finger at MCPJ	Ulnar nerve
Flexor digiti minimi brevis (red)	Flexes little finger at MCPJ	Ulnar nerve



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Question 52 of 102

Your consultant asks you to perform a neurological assessment of a trauma patient. The patient fell approximately 4 metres on a building site. Your consultant has arranged imaging that shows a possible injury of the C6, C7 and T1 vertebrae. The C6 dermatome is best tested at which of the following landmarks:

a On the lateral side of the antecubital fossa

b On the medial side of the antecubital fossa

c Dorsum of middle finger

d Dorsum of little finger

e Dorsum of thumb

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a) On the lateral side of the antecubital fossa
b) On the medial side of the antecubital fossa
c) Dorsum of middle finger
d) Dorsum of little finger
e) **Dorsum of thumb** ✔

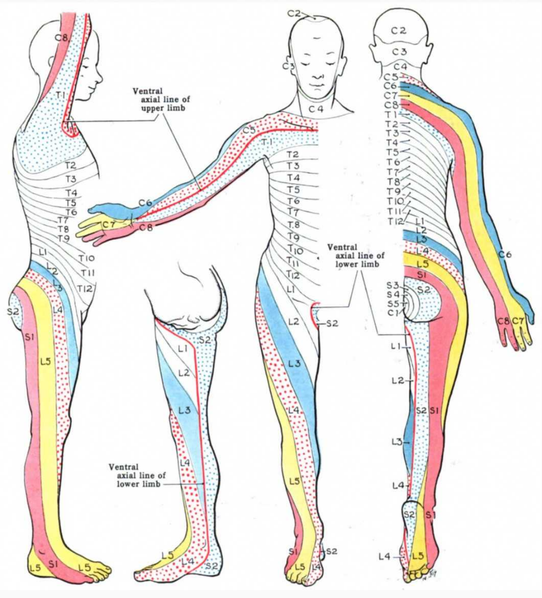
Answer

The C6 dermatome is best tested on the dorsal surface of the proximal phalanx of the thumb.

Notes

Dermatome	Landmark
C2	Occipital Protuberance
C3	Supraclavicular Fossa
C4	Acromioclavicular Joint
C5	Lateral Antecubital Fossa
C6	Thumb
C7	Middle Finger
C8	Little Finger
T1	Medial Antecubital Fossa
T2	Apex of Axilla

- The C2 dermatome is best tested at least one cm lateral to the occipital protuberance at the base of the skull. Alternately, it can be located at least 3 cm behind the ear.
- The C3 dermatome is best tested in the supraclavicular fossa, at the midclavicular line.
- The C4 dermatome is best tested over the acromioclavicular joint.
- The C5 dermatome is best tested on the lateral (radial) side of the antecubital fossa just proximal to the elbow.
- The C6 dermatome is best tested on the dorsal surface of the proximal phalanx of the thumb.
- The C7 dermatome is best tested on the dorsal surface of the proximal phalanx of the middle finger.
- The C8 dermatome is best tested on the dorsal surface of the proximal phalanx of the little finger.
- The T1 dermatome is best tested on the medial (ulnar) side of the antecubital fossa, just proximal to the medial epicondyle of the humerus.
- The T2 dermatome is best tested at the apex of the axilla.



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Anatomy: Forearm and Hand



Question 53 of 102

You are demonstrating a vascular examination on a patient to a group of medical students. Where is the radial artery pulsation best palpated:

a At the wrist just lateral to the flexor carpi radialis tendon

b At the wrist just medial to the flexor carpi radialis tendon

c At the wrist just medial to the flexor carpi ulnaris tendon

d At the wrist just lateral to the flexor carpi ulnaris tendon

e At the wrist just lateral to the palmaris longus tendon

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Anatomy: Forearm and Hand

Question 53 of 102

You are demonstrating a vascular examination on a patient to a group of medical students. Where is the radial artery pulsation best palpated:

a) **At the wrist just lateral to the flexor carpi radialis tendon** ✔
b) At the wrist just medial to the flexor carpi radialis tendon
c) At the wrist just medial to the flexor carpi ulnaris tendon
d) At the wrist just lateral to the flexor carpi ulnaris tendon
e) At the wrist just lateral to the palmaris longus tendon

Answer

In the distal forearm, the radial artery lies immediately lateral to the large tendon of the flexor carpi radialis muscle and directly anterior to the pronator quadratus and the distal end of the radius; the pulse can be located by using the flexor carpi radialis muscle as a landmark.

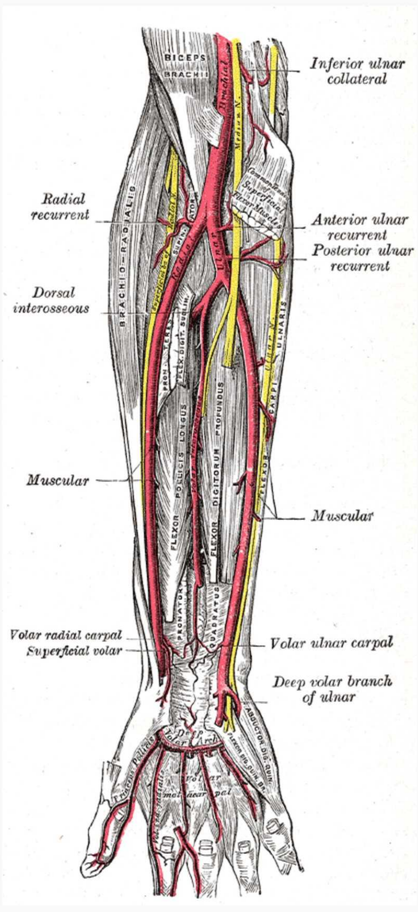
Notes

The radial artery, branch of the brachial artery, passes along the lateral aspect of the forearm, lying deep to the brachioradialis muscle proximally, and distally being covered only by skin and fascia, making this an ideal location to palpate the pulse or to gain arterial access (palpated just lateral to the flexor carpi radialis tendon, while compressing the artery against the radius bone). The radial artery enters the hand by curving around the lateral side of the wrist, passing over the floor of the anatomical snuffbox and penetrating the dorsolateral aspect of the hand between the bases of the first and second metacarpal bones.

The larger ulnar artery, also a branch of the brachial artery, enters the forearm by passing deep to the pronator teres muscle and passes down the medial side of the forearm between the flexor carpi ulnaris and the flexor digitorum profundus muscles. The ulnar artery enters the hand, passing lateral to the pisiform bone and superficial to the flexor retinaculum. The ulnar artery gives rise to the common interosseous artery.

The palmar and dorsal carpal arches are formed from anastomosis between the carpal branches of the radial and ulnar arteries, and supply the wrist and carpal bones.

Deep veins of the anterior compartment generally accompany the arteries and ultimately drain into brachial veins associated with the brachial artery in the cubital fossa.



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Anatomy: Forearm and Hand



Question 54 of 102

A 30 year old man attends ED with a deep knife wound to his distal forearm. He is unable to hold a piece of paper between his fingers and is complaining of loss of sensation over the medial side of his hand and little finger. Which of the following nerves is most likely to have been affected:

a Radial nerve

b Median nerve

c Ulnar nerve

d Posterior interosseous nerve

e Anterior interosseous nerve

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Question 54 of 102

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a) Radial nerve
b) Median nerve
c) **Ulnar nerve** ✔
d) Posterior interosseous nerve
e) Anterior interosseous nerve

Answer

The ulnar nerve innervates all of the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals, innervated by the median nerve). Adduction of the fingers is required to hold a piece of paper between the fingers, which is produced by the palmar interossei. The ulnar nerve supplies sensation to the dorsal and palmar aspect of the medial hand and the medial one and a half fingers.

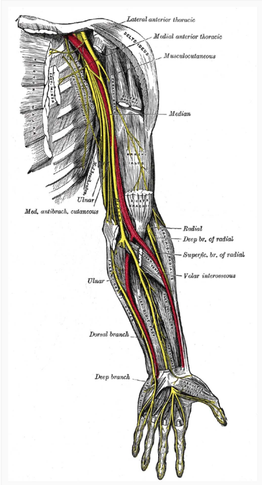
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting. N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrether (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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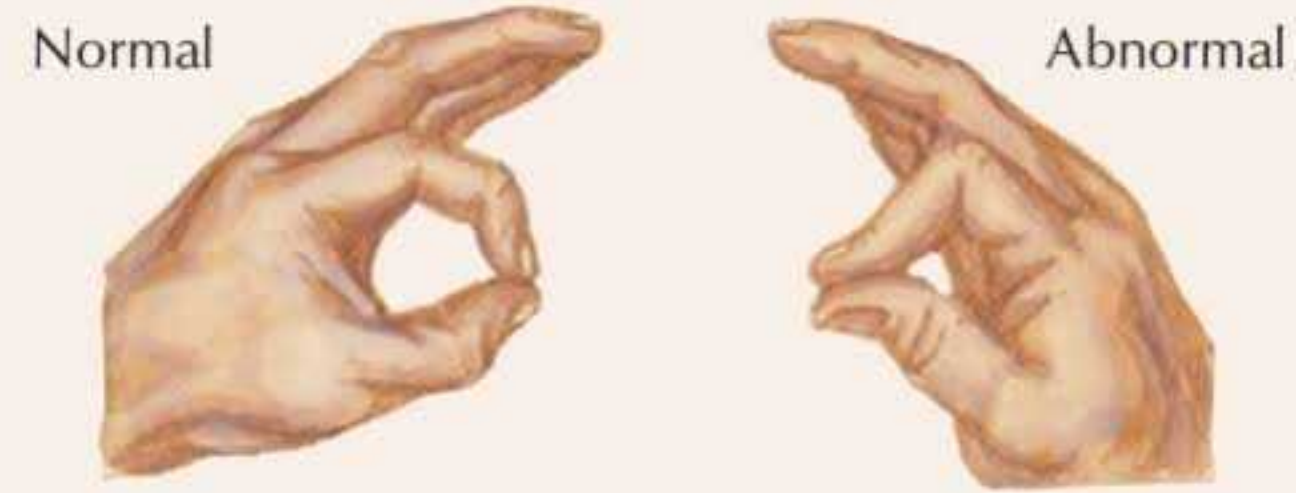
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Anterior interosseous syndrome



Hand posture in anterior interosseous syndrome due to paresis of flexor digitorum profundis and flexor pollicis longus mm.

Anatomy: Forearm and Hand



Question 55 of 102

You are giving a tutorial regarding forearm injuries to a group of final year medical students. You are discussing Galeazzi fractures. Which of the following synovial joint types best describes the radioulnar joints:

a Synovial plane joints

b Synovial modified hinge joints

c Synovial saddle joints

d Synovial condyloid joints

e Synovial pivot joints

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Anatomy: Forearm and Hand

Question 55 of 102

You are giving a tutorial regarding forearm injuries to a group of final year medical students. You are discussing Galeazzi fractures. Which of the following synovial joint types best describes the radioulnar joints:

a) Synovial plane joints
b) Synovial modified hinge joints
c) Synovial saddle joints
d) Synovial condyloid joints
e) **Synovial pivot joints** ✔

Answer

The radioulnar joints are synovial pivot joints.

Notes

The radioulnar joints allow pronation and supination of the forearm.

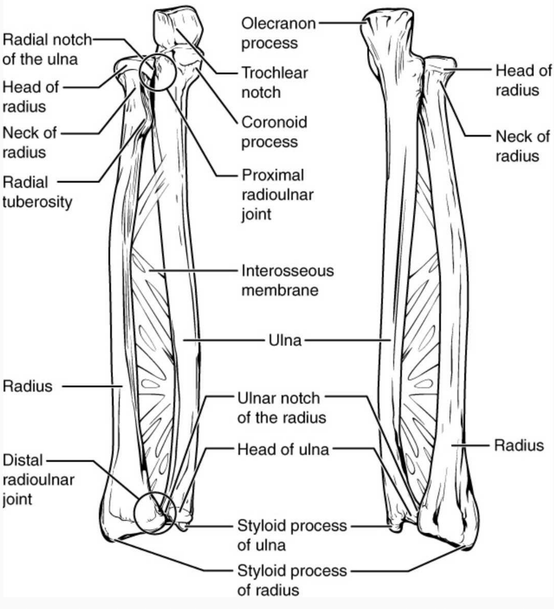
Movement	Muscles Involved
Pronation	Pronator quadratus, pronator teres
Supination	Supinator, biceps brachii

The proximal radioulnar joint is a pivot type synovial joint occurring between the head of the radius and the radial notch of the ulnar. The radial head is held in position by the annular ligament of the radius.

Joint	Proximal radioulnar joint
Type	Synovial pivot
Articulations	Head of radius with radial notch of ulna
Stabilising factors	Annular ligament
Movements	Pronation and supination

The distal radioulnar joint is a pivot type synovial joint occurring between the head of the ulnar and the ulnar notch on the radius.

Joint	Distal radioulnar joint
Type	Synovial pivot
Articulations	Head of ulna with ulnar notch of radius
Movements	Pronation and supination



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Anatomy: Forearm and Hand



Question 56 of 102

You have been asked to review a wound on the hand of a 42 year old gardener. He sustained a deep laceration to the right palm whilst cutting down a bush. You are concerned by the depth of the wound and consider if there has been damage to any underlying structures. The palmar aponeurosis originates from which of the following structures:

a Tendon of the flexor carpi ulnaris

b Tendon of the palmaris longus

c Tendon of the flexor carpi radialis

d Tendon of the flexor digitorum superficialis

e Tendon of the flexor digitorum profundus

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Anatomy: Forearm and Hand

Question 56 of 102

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a) Tendon of the flexor carpi ulnaris
b) **Tendon of the palmaris longus** ✔
c) Tendon of the flexor carpi radialis
d) Tendon of the flexor digitorum superficialis
e) Tendon of the flexor digitorum profundus

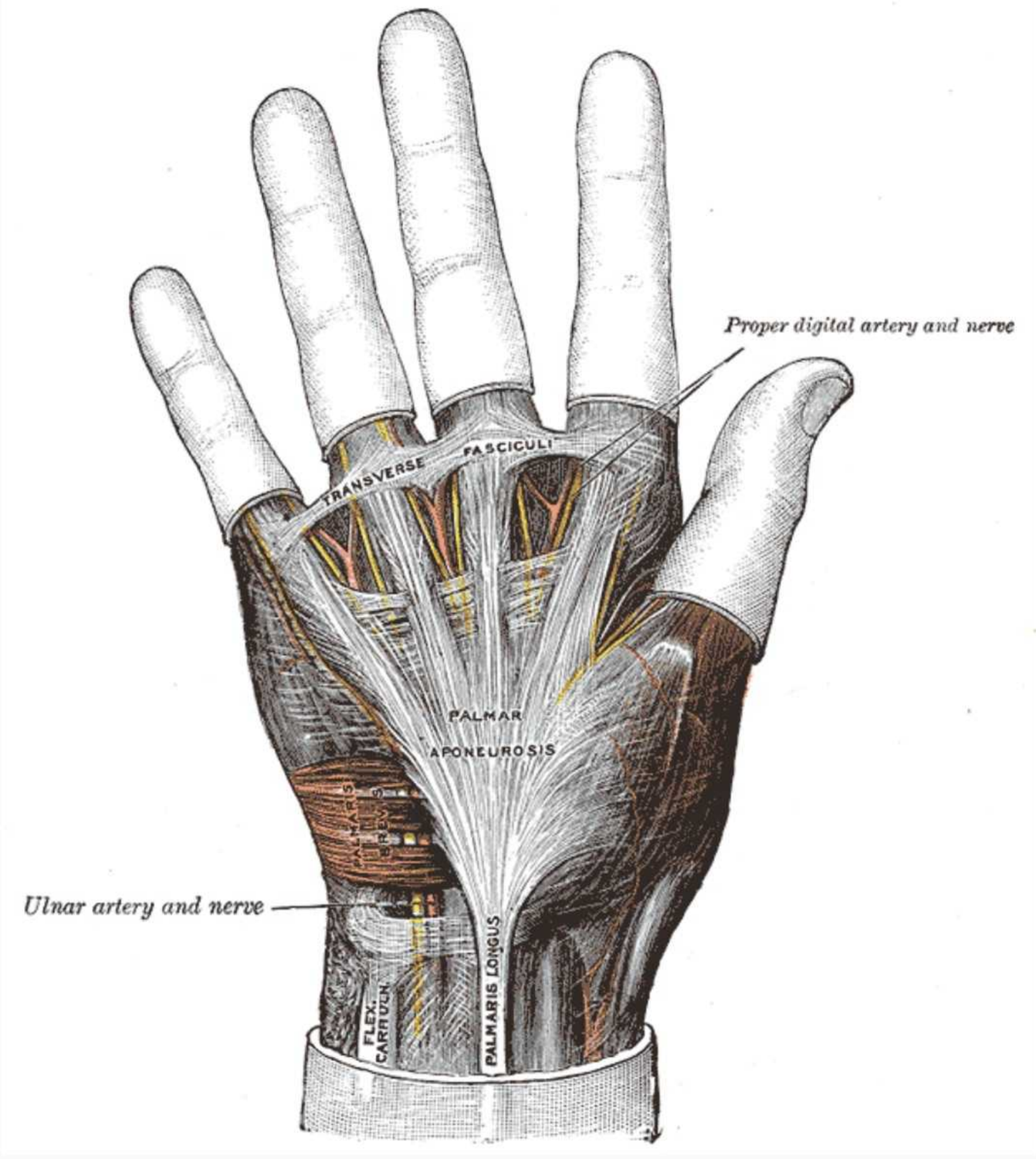
Answer

The palmar aponeurosis is continuous with the palmaris longus tendon.

Notes

The palmar aponeurosis is a thickened area of palmar fascia which is continuous proximally with the palmaris longus tendon and the flexor retinaculum. Distally, the palmar aponeurosis fans out into four slips which become the fibrous digital sheaths.

The palmar aponeurosis protects the underlying soft tissue and long flexor tendons. The fibrous digital sheaths cover the synovial sheaths which contain the flexor tendons, maintaining the tension and preventing bowstringing.



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Anatomy: Forearm and Hand



Question 57 of 102

A 43 year old artist presents to the ED complaining of numbness in his fingertips. On examination you note loss of sensation to the palmar aspect and fingertips of the lateral three and a half digits. Which of the following nerves is most likely affected:

a The superficial branch of the radial nerve

b The palmar cutaneous branch of the median nerve

c The palmar cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The palmar digital branch of the median nerve

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Anatomy: Forearm and Hand

Question 57 of 102

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a) The superficial branch of the radial nerve
b) The palmar cutaneous branch of the median nerve
c) The palmar cutaneous branch of the ulnar nerve
d) The superficial branch of the ulnar nerve
e) **The palmar digital branch of the median nerve** ✔

Answer

The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

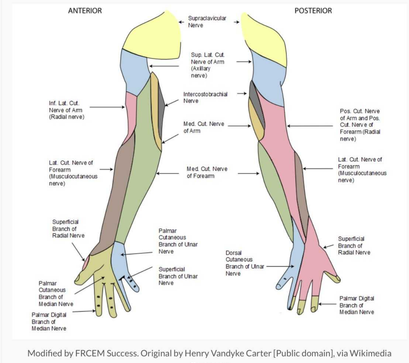
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 58 of 102

A 72 year old man is brought to the ED by his daughter. He is complaining of a numbness in his right arm. On examination you note he has lost sensation to the posterior forearm. The skin over the posterior forearm is supplied by which of the following nerves:

a The posterior cutaneous nerve of the forearm, branch of the ulnar nerve

b The posterior cutaneous nerve of the forearm, branch of the median nerve

c The posterior cutaneous nerve of the forearm, branch of the radial nerve

d The posterior cutaneous nerve of the forearm, branch of the musculocutaneous nerve

e The posterior cutaneous nerve of the forearm, from the brachial plexus

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Anatomy: Forearm and Hand

Question 58 of 102

A 72 year old man is brought to the ED by his daughter. He is complaining of a numbness in his right arm. On examination you note he has lost sensation to the posterior forearm. The skin over the posterior forearm is supplied by which of the following nerves:

a) The posterior cutaneous nerve of the forearm, branch of the ulnar nerve
b) The posterior cutaneous nerve of the forearm, branch of the median nerve
c) **The posterior cutaneous nerve of the forearm, branch of the radial nerve** ✔
d) The posterior cutaneous nerve of the forearm, branch of the musculocutaneous nerve
e) The posterior cutaneous nerve of the forearm, from the brachial plexus

Answer

The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

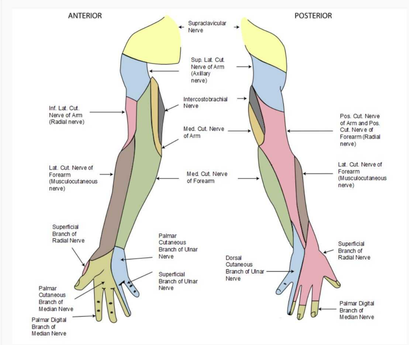
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 59 of 102

A 16 year old boy sustains a supracondylar fracture falling off his skateboard. He is unable to flex the distal interphalangeal joint of his index finger. Which of the following clinical finding are you most likely to see on further examination:

a Inability to flex the distal interphalangeal joint of the ring finger

b Loss of supination of the forearm

c Loss of sensation over the lateral dorsum of the hand.

d Inability to oppose the thumb

e Inability to abduct the fingers

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Anatomy: Forearm and Hand

Question 59 of 102

A 16 year old boy sustains a supracondylar fracture falling off his skateboard. He is unable to flex the distal interphalangeal joint of his index finger. Which of the following clinical finding are you most likely to see on further examination:

a) Inability to flex the distal interphalangeal joint of the ring finger
b) Loss of supination of the forearm
c) Loss of sensation over the lateral dorsum of the hand.
d) **Inability to oppose the thumb** ✔
e) Inability to abduct the fingers

Answer

A supracondylar fracture is most commonly associated with damage to the median nerve. Paralysis of the lateral half of the flexor digitorum profundus would cause loss of flexion at the distal interphalangeal joint of the index finger but not the ring finger, as the medial half is innervated by the ulnar nerve. Median nerve injury results in paralysis of the thenar muscles with loss of opposition of the thumb.

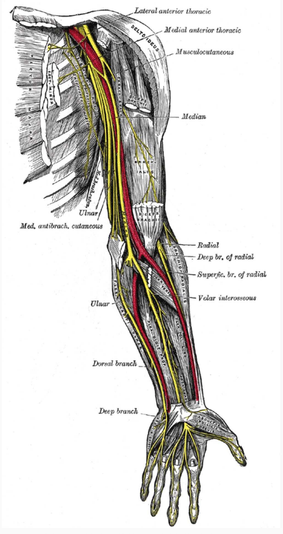
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 60 of 102

A 20 year old woman sustains an injury to the median nerve at the wrist after self harming. Which of the following clinical features would you least expect to see:

a Loss of abduction and opposition of the thumb

b Loss of sensation over lateral half of palm

c Loss of sensation to skin over palmar surface of lateral 3 and a half digits

d Weakness of flexion of the index and middle finger

e Thenar eminence wasting

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Anatomy: Forearm and Hand

Question 60 of 102

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a) **Loss of abduction and opposition of the thumb** ✗
b) Loss of sensation over lateral half of palm ✓
c) Loss of sensation to skin over palmar surface of lateral 3 and a half digits
d) Weakness of flexion of the index and middle finger
e) Thenar eminence wasting

Answer

In a wrist lesion, typically the palmar cutaneous nerve is spared as this arises in the forearm, thus you would not expect loss of sensation over the lateral half of the palm. Loss of sensation over the palmar surface of the lateral three and a half digits may occur. Weakness of opposition and abduction of the thumb occur due to paralysis of the thenar muscles. Thenar eminence wasting may occur.

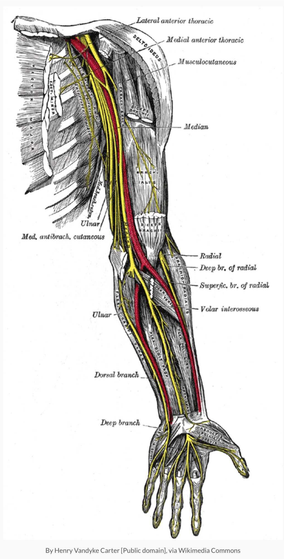
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 61 of 102

A 69 year old lady presents to ED having tripped on a curb and fallen on her left arm. Imaging shows a midshaft fracture of the humerus. Which of the following structures was most likely injured:

a Axillary nerve and axillary artery

b Radial nerve and deep brachial artery

c Axillary nerve and posterior humeral circumflex artery

d Long thoracic nerve and lateral thoracic artery

e Ulnar nerve and cephalic vein

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Anatomy: Forearm and Hand

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a) Axillary nerve and axillary artery
b) **Radial nerve and deep brachial artery** ✔
c) Axillary nerve and posterior humeral circumflex artery
d) Long thoracic nerve and lateral thoracic artery
e) Ulnar nerve and cephalic vein

Answer

A midshaft humeral fracture may injure the radial nerve and brachial artery where they lie together in the spiral groove of the humerus.

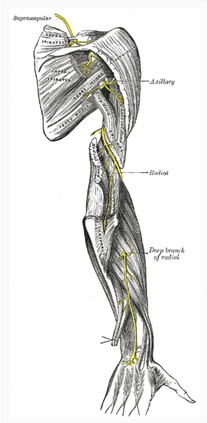
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 62 of 102

A 29 year old woman presents to ED after injuring her left elbow. She is complaining of weak grip in her left hand. You ask her to hold onto a piece of paper with both hands as you try to pull it away from her. She is unable to hold onto the piece of paper in her left hand without flexing the distal joint of the thumb. Which of the following nerves is most likely to be damaged:

a Axillary

b Median

c Musculocutaneous

d Radial

e Ulnar

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Anatomy: Forearm and Hand

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a) Axillary
b) Median
c) Musculocutaneous
d) Radial
e) **Ulnar** ✔

Answer

This is a positive Froment's sign, which is seen in ulnar neuropathy, caused by weakness of the adductor pollicis muscle.

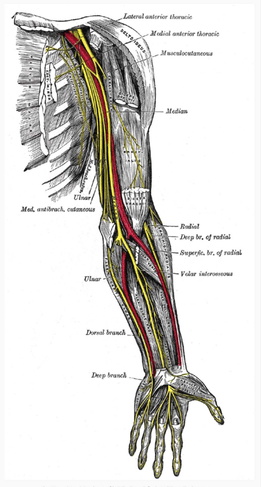
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

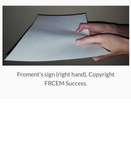
Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 63 of 102

You are examining the arm of a 34 year old man who has injured his radial nerve. You test the muscles supplied by the radial nerve. The brachioradialis muscle primarily assists with which of the following movements:

a Flexion of the forearm

b Flexion of the arm

c Flexion of the hand

d Supination of the forearm

e Pronation of the forearm

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a) **Flexion of the forearm** ✔
b) Flexion of the arm
c) Flexion of the hand
d) Supination of the forearm
e) Pronation of the forearm

Answer

The brachioradialis muscle is an accessory flexor of the forearm at the elbow (together with the biceps brachii and the brachialis). It is located in the posterior compartment of the forearm.

Notes

The muscles of the posterior forearm are all innervated by the radial nerve.

The posterior forearm is divided into the superficial and deep groups:

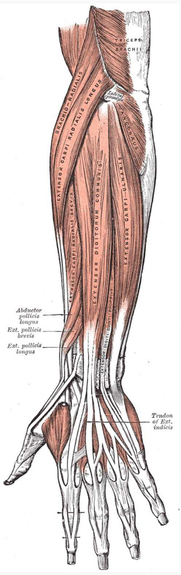
- The superficial group is made up of the brachioradialis, the extensor carpi radialis longus and brevis, the extensor digitorum, the extensor digiti mini, the anconeus and the extensor carpi ulnaris.
- The deep group is made up of the supinator, the abductor pollicis longus, the extensor pollicis longus and brevis and the extensor indicis.

Muscle	Action	Innervation
Brachioradialis	Flexion of elbow	Radial nerve
Extensor carpi radialis longus	Extension and abduction of wrist	Radial nerve
Extensor carpi radialis brevis	Extension and abduction of wrist	Radial nerve
Extensor digitorum	Extension of all four fingers, extension of wrist	Radial nerve
Extensor digiti minimi	Extension of little finger	Radial nerve
Extensor carpi ulnaris	Extension and adduction of wrist	Radial nerve
Supinator	Supination of forearm	Radial nerve
Abductor pollicis longus	Abduction and extension of thumb	Radial nerve
Extensor pollicis longus	Extension of thumb (CMCJ, MCPJ, IPJ)	Radial nerve
Extensor pollicis brevis	Extension of thumb (CMCJ and MCPJ)	Radial nerve
Extensor indicis	Extension of index finger	Radial nerve

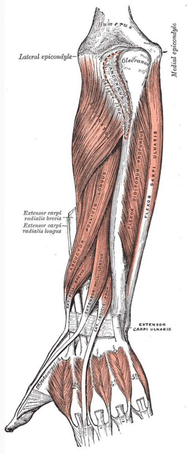
A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The abductor pollicis longus is attached distally to the lateral side of base of the 1st metacarpal.
- The extensor pollicis brevis is attached to the proximal phalanx of the thumb and the extensor pollicis longus is attached to the distal phalanx of the thumb.
- The extensor carpi radialis longus is attached to the base of the 2nd metacarpal and the extensor carpi radialis brevis is attached to the bases of the 2nd and 3rd metacarpals.
- The extensor digitorum is attached to the base of the middle and distal phalanges of digits 2 – 5 via extensor hoods.
- The extensor carpi ulnaris is attached to the base of the 5th metacarpal.
- The extensor digiti minimi is attached to the base of the 5th metacarpal.
- The extensor indicis is attached to the extensor hood of the index finger.

Muscle tendon	Distal attachment
Extensor carpi radialis longus	Dorsal surface of base of 2nd metacarpal
Extensor carpi radialis brevis	Dorsal surface of base of 2nd and 3rd metacarpal
Extensor digitorum	Dorsal aspects of bases of middle and distal phalanges of all four fingers via extensor hoods
Extensor carpi ulnaris	Tubercle on base of medial 5th metacarpal
Abductor pollicis longus	Lateral side of base of 1st metacarpal
Extensor pollicis longus	Dorsal surface of base of distal phalanx of thumb
Extensor pollicis brevis	Dorsal surface of base of proximal phalanx of thumb
Extensor indicis	Extensor hood of index finger



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Anatomy: Forearm and Hand



Question 64 of 102

A 28 year old man presents to ED with a stab wound to the first dorsal compartment of the wrist of his left hand. Which of the following tendons may be affected in this injury:

a Extensor carpi radialis longus and brevis

b Extensor pollicis brevis and abductor pollicis longus

c Extensor pollicis longus and extensor pollicis brevis

d Abductor pollicis longus and brevis

e Extensor pollicis longus

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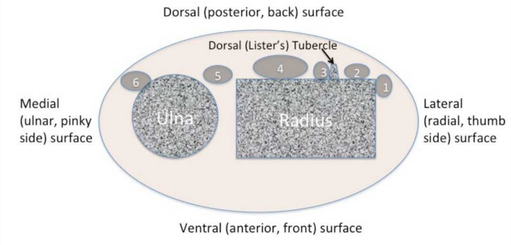
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a) Extensor carpi radialis longus and brevis
b) **Extensor pollicis brevis and abductor pollicis longus** ✔
c) Extensor pollicis longus and extensor pollicis brevis
d) Abductor pollicis longus and brevis
e) Extensor pollicis longus

Answer

Extensor tendons in the dorsal compartments of the wrist (from lateral to medial):

1. Extensor pollicis brevis and abductor pollicis longus
2. Extensor carpi radialis longus and brevis
3. Extensor pollicis longus
4. Extensor digitorum and extensor indicis
5. Extensor digiti minimi
6. Extensor carpi ulnaris



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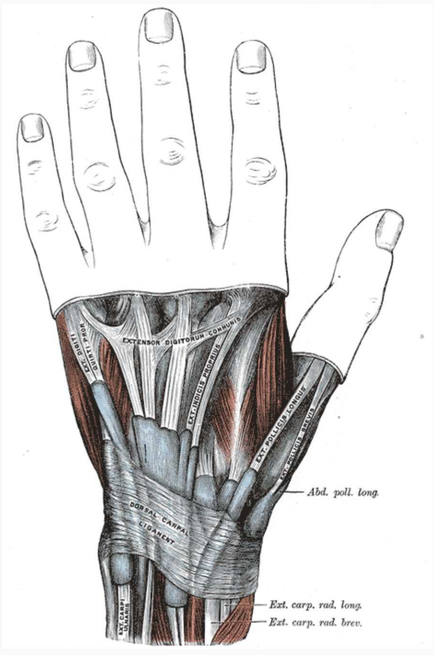
Notes

The extensor retinaculum (dorsal carpal ligament) lies obliquely across the extensor surface of the wrist joint, and holds the extensor tendons in place during movement of the wrist.

It is attached laterally to the anterolateral radius above the styloid process and medially to the pisiform and triquetrum bones. It does NOT attach to the ulna.

The extensor tendons pass through the extensor tunnel, deep to the extensor retinaculum, in six compartments lined by synovial sheaths:

- The tendons of the extensor digitorum and extensor indicis share a synovial sheath on the posterior surface of the wrist
- The tendons of the extensor carpi ulnaris and extensor digiti minimi have separate sheaths on the medial side of the wrist
- The tendons of the abductor pollicis longus and extensor pollicis brevis, the extensor carpi radialis longus and extensor carpi radialis brevis and the extensor pollicis longus have three separate sheaths on the lateral side of the wrist



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Anatomy: Forearm and Hand



Question 65 of 102

A 54 year old woman presents to the ED complaining of pain and swelling over the site of her recent carpal tunnel decompression. Which of the following structures passes into the hand anterior to the flexor retinaculum:

a Flexor carpi radialis tendon

b Flexor pollicis longus tendon

c Median nerve

d Flexor digitorum superficialis tendon

e Ulnar artery

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Anatomy: Forearm and Hand

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a) Flexor carpi radialis tendon
b) Flexor pollicis longus tendon
c) **Median nerve** ✖
d) Flexor digitorum superficialis tendon
e) Ulnar artery ✔

Answer

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

Notes

The flexor retinaculum (transverse carpal ligament) is a thickened band of fibrous connective tissue on the volar aspect of the hand which forms the roof of the carpal tunnel. The flexor retinaculum holds the flexor tendons in place at the wrist and prevents them from bowstringing.

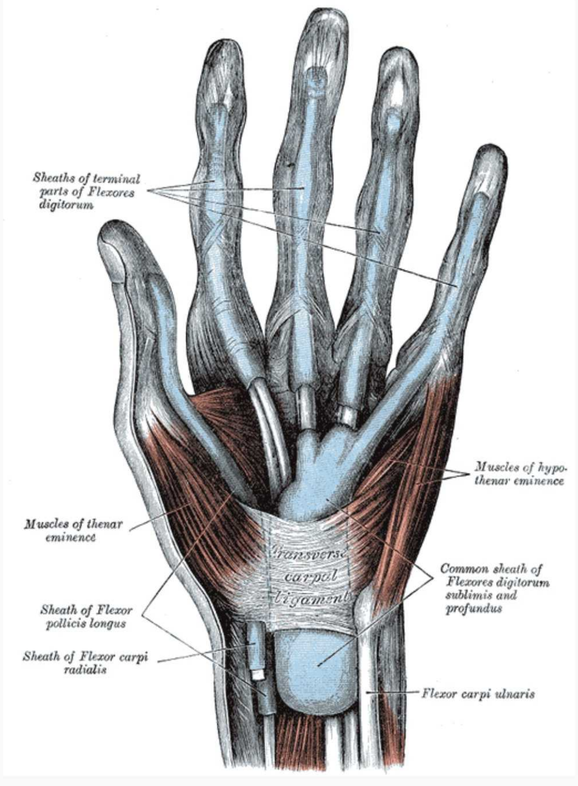
It is attached laterally to the scaphoid and trapezium and medially to the pisiform and the hook of the hamate.

The thenar and hypothenar muscles arise from the flexor retinaculum.

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

The flexor carpi radialis tendon passes through the lateral aspect of the flexor retinaculum into the hand.

The four tendons of the flexor digitorum profundus, the four tendons of the flexor digitorum superficialis, the tendon of the flexor pollicis longus and the median nerve pass into the hand posterior to the flexor retinaculum, within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 66 of 102

A patient presents to ED complaining of pins and needles over the lateral three and a half digits. You suspect carpal tunnel syndrome. Which of the following clinical features would you most expect to see on examination:

a Atrophy of the adductor pollicis muscle

b Inability to abduct the index finger

c Inability to flex the distal interphalangeal joint of the index finger

d Inability to flex the interphalangeal joint of the thumb

e Inability to touch the pad of the little finger with the thumb

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Anatomy: Forearm and Hand

Question 66 of 102

A patient presents to ED complaining of pins and needles over the lateral three and a half digits. You suspect carpal tunnel syndrome. Which of the following clinical features would you most expect to see on examination:

a) Atrophy of the adductor pollicis muscle
b) Inability to abduct the index finger
c) Inability to flex the distal interphalangeal joint of the index finger
d) **Inability to flex the interphalangeal joint of the thumb** ✗
e) Inability to touch the pad of the little finger with the thumb ✓

Answer

Compression of the median nerve in the carpal tunnel will result in weakness and atrophy of the thenar muscles – resulting in weakness of opposition, abduction and flexion of the thumb at the metacarpophalangeal joint and anaesthesia or paraesthesia over the distribution of the palmar digital branch of the median nerve (skin over the palmar surface and fingertips of the lateral three and a half digits). The adductor pollicis muscle is innervated by the ulnar nerve, and abduction of the fingers is produced by the interossei, also innervated by the ulnar nerve. Flexion of the interphalangeal joint of the thumb is produced by the flexor pollicis longus, and flexion of the distal interphalangeal joint of the index finger is produced by the flexor digitorum profundus. Median nerve injury at the wrist will not affect the long flexors of the forearm as these are innervated by the anterior interosseous nerve which arises in the proximal forearm.

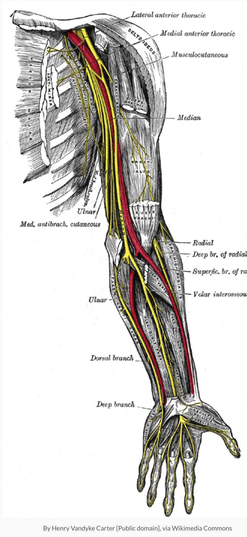
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 67 of 102

A patient presents to ED complaining of weakness in her left arm. She tells you she sustained a fracture to this arm about 2 months ago, but is unable to give you more detail. Examination reveals loss of wrist extension and weakness of grasp. Extension at the elbow joint is normal, and there is no loss of sensation. Which of the following nerves is most likely affected:

a Posterior interosseous nerve

b Superficial branch of the radial nerve

c Recurrent branch of the median nerve

d Ulnar nerve

e Anterior interosseous nerve

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Anatomy: Forearm and Hand

A patient presents to ED complaining of weakness in her left arm. She tells you she sustained a fracture to this arm about 2 months ago, but is unable to give you more detail. Examination reveals loss of wrist extension and weakness of grasp. Extension at the elbow joint is normal, and there is no loss of sensation. Which of the following nerves is most likely affected:

a) **Posterior interosseous nerve** ✔
b) Superficial branch of the radial nerve
c) Recurrent branch of the median nerve
d) Ulnar nerve
e) Anterior interosseous nerve

Answer

The posterior interosseous nerve is the continuation of the deep branch of the radial nerve which innervates the muscles of the posterior compartment of the forearm. Damage to this nerve may occur due to fracture of the radial head or posterior dislocation of radius and results in weakness of wrist extension and finger extension (resulting in weak finger flexion and grip strength as the long flexor tendons are not under tension). The superficial branch of the radial nerve supplies skin over the dorsum of the lateral hand and lateral three and a half fingers and thus is not affected in this case. The anterior interosseous nerve is a branch of the median nerve supplying muscles in the anterior forearm and the recurrent branch innervates the thenar muscles.

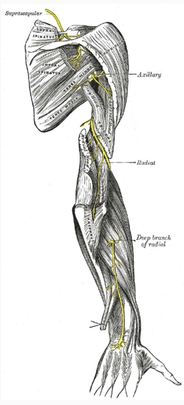
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 68 of 102

A patient presents to ED complaining of weakness in her right hand. After examination, you suspect weakness of the lumbrical muscles. Regarding the lumbrical muscles, which of the following statements is CORRECT:

a The lumbrical muscles originate from the tendons of the flexor digitorum superficialis muscle.

b The lumbrical muscles insert into the distal phalanges of the medial four fingers.

c The lumbrical muscles act to flex the fingers at the metacarpophalangeal joints.

d The lumbrical muscles are all innervated by the ulnar nerve.

e The lumbrical muscles act to flex the fingers at the interphalangeal joints.

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Question 68 of 102

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a) The lumbrical muscles originate from the tendons of the flexor digitorum superficialis muscle.
b) The lumbrical muscles insert into the distal phalanges of the medial four fingers.
c) **The lumbrical muscles act to flex the fingers at the metacarpophalangeal joints.** ✔
d) The lumbrical muscles are all innervated by the ulnar nerve.
e) The lumbrical muscles act to flex the fingers at the interphalangeal joints.

Answer

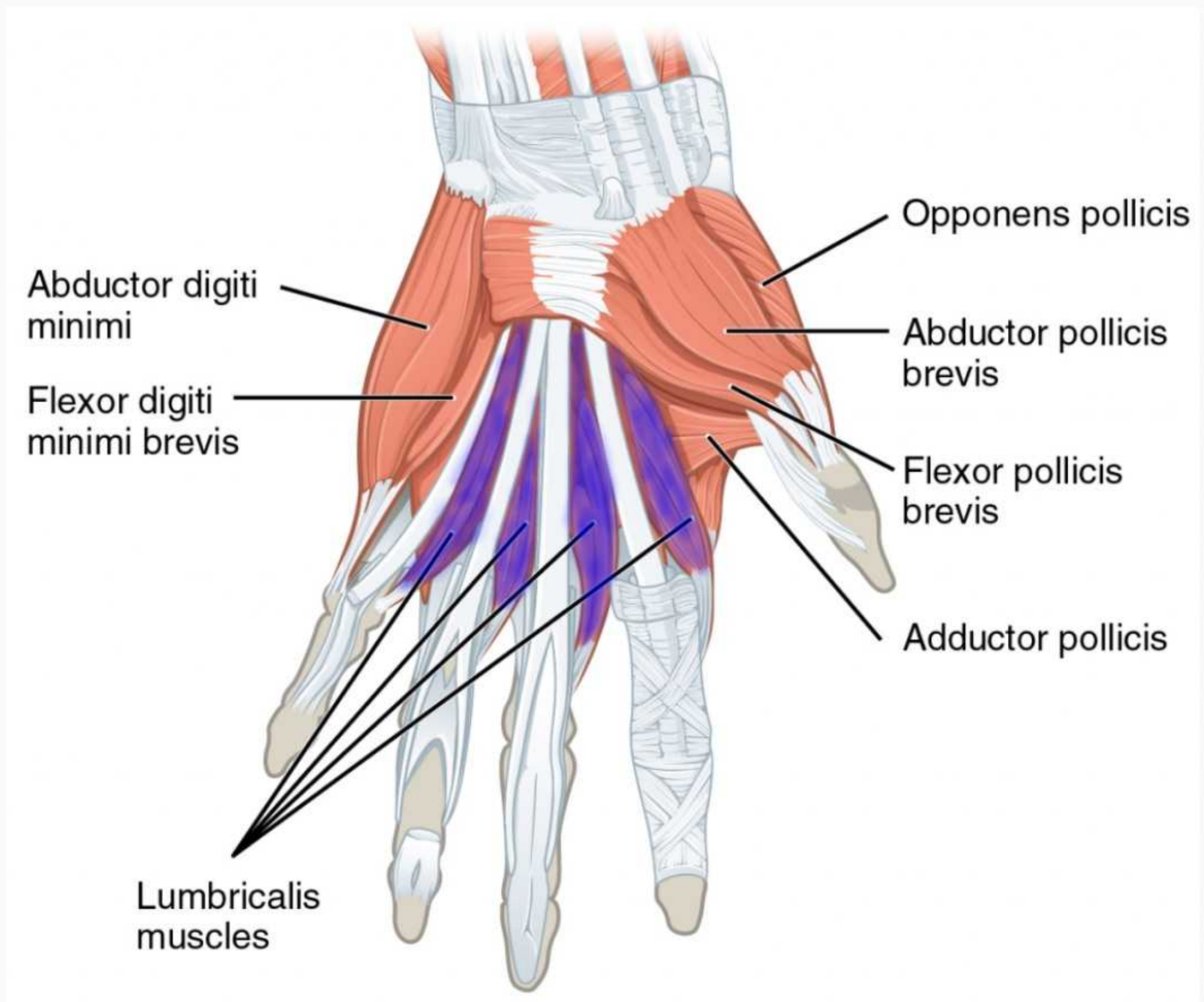
The lumbrical muscles act to flex these fingers at the metacarpophalangeal joints (MCPJs) and extend them at the interphalangeal joints (IPJs).

Notes

The lumbrical muscles originate from the tendons of the flexor digitorum profundus in the palm and insert into the extensor hoods of the medial four fingers.

The lumbrical muscles act to flex these fingers at the metacarpophalangeal joints (MCPJs) and extend them at the interphalangeal joints (IPJs).

The medial two lumbricals are innervated by the ulnar nerve and the lateral two lumbricals are innervated by the median nerve.



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Anatomy: Forearm and Hand



Question 69 of 102

A patient presents to ED complaining of pain and paraesthesia in her right hand which becomes worse at night. Her symptoms have been ongoing for about 6 months. You suspect carpal tunnel syndrome. Which of the following muscles would you most expect to be atrophied on examination:

a Hypothenar muscles

b Dorsal interossei

c Thenar muscles

d Palmar interossei

e Medial two lumbricals

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a) Hypothenar muscles
b) Dorsal interossei
c) **Thenar muscles** ✔
d) Palmar interossei
e) Medial two lumbricals

Answer

Carpal tunnel syndrome results from compression of the median nerve in the carpal tunnel. Typically there is pain and paraesthesia in the cutaneous distribution of the median nerve (palmar surface and fingertips of lateral three and a half digits – lateral palm is spared), and weakness and wasting of the thenar muscles with weak thumb grip. Symptoms may be reproduced by performing Phalen's test (with sustained flexion of the wrist) or Tinel's test (by tapping lightly over the median nerve at the wrist). The hypothenar muscles, interossei and medial two lumbricals are all innervated by the ulnar nerve.

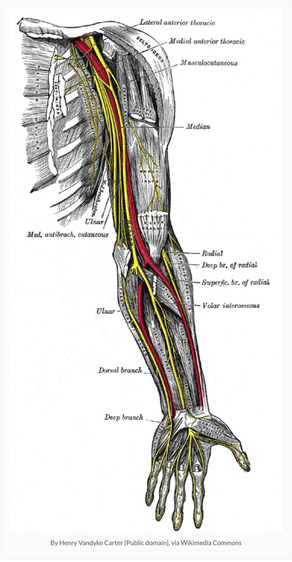
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



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Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 70 of 102

A 16 year old boy is brought to ED having fallen off his skateboard. He is complaining of pain and weakness in his right upper limb. Imaging shows a fracture of the medial epicondyle. Which of the following movements would you most expect to be affected in this type of injury:

a Abduction of the thumb

b Extension of the thumb

c Opposition of the thumb

d Adduction of the thumb

e Flexion of the thumb

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Anatomy: Forearm and Hand

Question 70 of 102

A 16 year old boy is brought to ED having fallen off his skateboard. He is complaining of pain and weakness in his right upper limb. Imaging shows a fracture of the medial epicondyle. Which of the following movements would you most expect to be affected in this type of injury:

a) Abduction of the thumb
b) Extension of the thumb
c) Opposition of the thumb
d) **Adduction of the thumb** ✔
e) Flexion of the thumb

Answer

Fracture of the medial epicondyle is most likely to result in damage to the ulnar nerve. The adductor pollicis muscle is innervated by the ulnar nerve. The thumb extensors are innervated by the radial nerve. The thumb abductors are innervated by the radial and median nerve. The thumb flexors are innervated by the median nerve. The opponens pollicis is innervated by the median nerve.

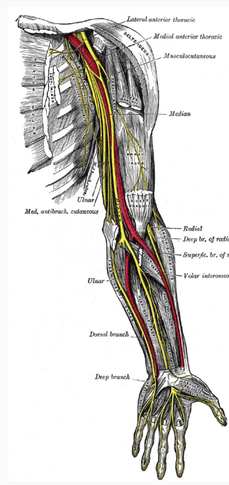
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



By Henry Vandyke Carter [Public domain], via Wikimedia Commons

Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting. N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrether (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 71 of 102

A patient presents to ED having fallen on her left arm at a roller disco party. She has fractured the medial epicondyle of the humerus and damaged the nerve most commonly associated with this type of injury. Which of the following would you most expect to be affected:

a Flexion of the proximal interphalangeal joint of the ring ringer

b Flexion of the distal interphalangeal joint of the index finger

c Abduction of the index finger

d Abduction of the thumb

e Sensation over the middle finger

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Anatomy: Forearm and Hand

Question 71 of 102

A patient presents to ED having fallen on her left arm at a roller disco party. She has fractured the medial epicondyle of the humerus and damaged the nerve most commonly associated with this type of injury. Which of the following would you most expect to be affected:

a) Flexion of the proximal interphalangeal joint of the ring finger ✘
b) Flexion of the distal interphalangeal joint of the index finger
c) Abduction of the index finger ✔
d) Abduction of the thumb
e) Sensation over the middle finger

Answer

The ulnar nerve is the most commonly injured nerve in a medial epicondyle fracture. Abduction of the index finger is produced by the dorsal interosseei innervated by the ulnar nerve. Flexion of the proximal interphalangeal joint of the ring finger is produced by the flexor digitorum superficialis innervated by the median nerve. Flexion of the distal interphalangeal joint of the index finger is produced by the lateral half of the flexor digitorum profundus innervated by the median nerve. Abduction of the thumb is produced by the abductor pollicis longus and brevis innervated by the median nerve. Sensation over the medial finger is supplied by the median nerve.

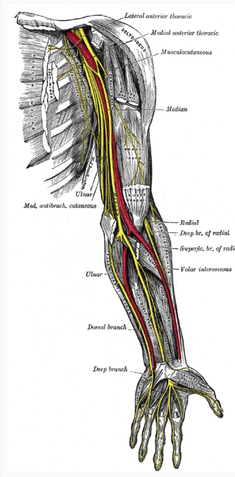
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



By Henry Vandyke Carter [Public domain], via Wikimedia Commons

Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 72 of 102

A 21 year old female presents to ED following an attempted suicide attempt. She has a deep laceration to her anterior forearm. Further exploration shows she has divided the flexor digitorum superficialis muscle and has injured the nerve that lies between this and the flexor digitorum profundus muscle. Which of the following movements would most likely be affected as a result of this injury:

a Abduction of the fingers

b Opposition of the thumb

c Adduction of the thumb

d Extension of the fingers at the metacarpophalangeal joints

e Adduction of the wrist

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a) Abduction of the fingers
b) **Opposition of the thumb** ✔
c) Adduction of the thumb
d) Extension of the fingers at the metacarpophalangeal joints
e) Adduction of the wrist

Answer

The median nerve lies between the flexor digitorum superficialis and flexor digitorum profundus in the anterior arm. The median nerve innervates the thenar muscles thus injury will result in weakness of thumb abduction, flexion and opposition. The adductor pollicis is innervated by the ulnar nerve. The wrist adductors are innervated by the ulnar and radial nerves. The finger extensors are innervated by the radial nerve. Abduction of the fingers is produced by the interossei, innervated by the ulnar nerve.

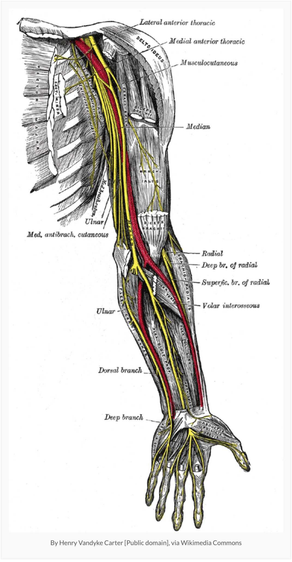
Notes

The median nerve is formed from the medial and lateral brachial plexus cords and contains fibres from all five roots (C5 – T1).

Nerve	Median nerve
Nerve roots	C5 – T1
Plexus cords	Medial and lateral cords
Motor Supply	All the anterior forearm muscles (except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus), the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis) and the lateral two lumbricals
Sensory supply	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits

Anatomical course

The median nerve originates in the axilla before passing down the medial side of the arm (initially lateral to the brachial artery before crossing over to the medial side of the brachial artery). It enters the anterior compartment of the forearm via the antecubital fossa, travelling between the flexor digitorum profundus and flexor digitorum superficialis muscles, before entering the hand via the carpal tunnel and bifurcating into its terminal branches.



By Henry Vandyke Carter [Public domain], via Wikimedia Commons

Branches

Branches of Median Nerve	Origin	Supply
Median nerve	Axilla	Superficial and intermediate compartment of anterior forearm (pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, NOT flexor carpi ulnaris)
Anterior interosseous nerve	Forearm	Deep compartment of anterior forearm (flexor pollicis longus, pronator quadratus, lateral half of flexor digitorum profundus)
Palmar cutaneous branch	Forearm	Skin over the lateral aspect of the palm
Recurrent branch of median nerve	Hand	Thenar muscles (flexor pollicis brevis, abductor pollicis brevis, opponens pollicis)
Palmar digital branch	Hand	Lateral two lumbricals and skin over the palmar surface and fingertips of the lateral three and a half digits

The median nerve directly innervates the pronator teres, the flexor carpi radialis, the palmaris longus and the flexor digitorum superficialis. It gives off no major branches in the arm, but gives rise to the anterior interosseous nerve (innervating the flexor pollicis longus, the pronator quadratus, and the lateral half of the flexor digitorum profundus) and the palmar cutaneous nerve (innervating the lateral aspect of the palm) in the forearm.

In the hand the median nerve bifurcates into the recurrent branch of the median nerve (innervating the thenar muscles) and the palmar digital branch (innervating the lateral two lumbricals and the skin over the palmar surface and fingertips of the lateral three and a half digits).

Clinical implications

Lesion	Proximal (arm, elbow, proximal forearm)	Distal (wrist)
Mechanisms	Supracondylar fracture, stab wound to arm or forearm	Lacerations just proximal to flexor retinaculum, carpal tunnel syndrome
Motor Loss	Forearm pronation, wrist flexion and abduction, index and middle finger flexion, thumb flexion, abduction and opposition	Thumb flexion, abduction and opposition, flexion of index and middle finger MCPJ
Sensory Loss	Lateral aspect of palm and palmar surface and fingertips of lateral three and a half digits	Palmar surface and fingertips of lateral three and a half digits
Signs	Forearm rests in supination with wrist in ulnar deviation and thumb extended, thenar eminence wasting, hand of Benediction (when asked to make a fist, the patient will be able to flex the little and ring fingers but not the index and middle fingers)	Thenar eminence wasting

A proximal median nerve lesion at the elbow may occur due to supracondylar fracture of the humerus or from deep penetrating wounds to the arm or forearm and may result in:

- Pronation of the forearm and flexion and abduction of the wrist are lost due to paralysis of the flexors and pronators in the forearm. The forearm thus often rests in supination with ulnar deviation of the wrist (due to unopposed action of the flexor carpi ulnaris).
- Flexion, abduction and opposition of the thumb at the MCPJ and IPJ are lost due to paralysis of the thenar muscles and the flexor pollicis longus.
- Flexion of the index and middle fingers at the IPJs is lost due to paralysis of the flexor digitorum superficialis and the lateral half of the flexor digitorum profundus.
- Flexion of the MCPJ of the index and middle fingers is lost due to paralysis of the lateral two lumbrical muscles.
- N.B. Flexion of the ring and little fingers at the MCPJ and DIPJ are preserved as these are functions of the medial half of the flexor digitorum profundus and the medial two lumbrical muscles, innervated by the ulnar nerve (there may be weakness of flexion at the PIPJ of these fingers due to paralysis of the flexor digitorum superficialis).
- There is loss of sensation over the lateral aspect of the palm, and the skin over the palmar surface and fingertips of the lateral three and a half digits.

Medial nerve lesion at the wrist often occurs due to lacerations just proximal to the flexor retinaculum or to compression of the median nerve in the carpal tunnel. Only the intrinsic hand muscles are affected. Loss of opposition, abduction and flexion of the MCPJ of the thumb occurs due to paralysis of the thenar muscles. Loss of flexion at the MCPJ of the index and middle finger occurs due to paralysis of the lateral two lumbricals. There is loss of sensation to the palmar surface and fingertips of the lateral three and a half digits only (the palmar region is spared).

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Anatomy: Forearm and Hand



Question 73 of 102

A 21 year old man presents to ED with multiple lacerations to his right upper limb, after falling through a ground floor window during a fight. He is unable to flex the distal interphalangeal joints of the fourth and fifth digits. Which of the following muscles is most likely affected:

a Flexor digitorum superficialis

b Flexor digitorum profundus

c Lumbricals

d Flexor carpi ulnaris

e Interossei

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Question 73 of 102

A 21 year old man presents to ED with multiple lacerations to his right upper limb, after falling through a ground floor window during a fight. He is unable to flex the distal interphalangeal joints of the fourth and fifth digits. Which of the following muscles is most likely affected:

a) Flexor digitorum superficialis
b) **Flexor digitorum profundus** ✔
c) Lumbricals
d) Flexor carpi ulnaris
e) Interossei

Answer

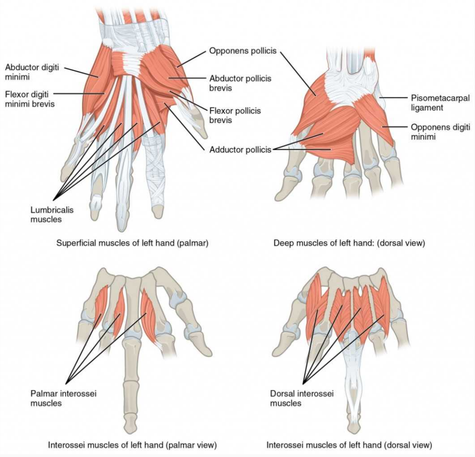
The ulnar nerve runs a superficial course and is vulnerable to laceration. The flexor digitorum profundus, innervated by the ulnar nerve medially and the median nerve laterally, acts to flex the distal interphalangeal joints and the metacarpophalangeal joints of the medial four fingers. The flexor digitorum superficialis, innervated by the deeper median nerve, acts to flex the proximal interphalangeal joints and the metacarpophalangeal joints of the medial four fingers. The flexor carpi ulnaris acts to flex and adduct the wrist. The interossei mainly act to adduct and abduct the fingers. The lumbricals act to flex the medial four fingers at the metacarpophalangeal joints and extend them at the interphalangeal joints.

Notes

Hand movements are complex. The table below shows an overview of hand and thumb movements and the main muscles bringing about these movements.

Hand movements	Primary muscle (assisting muscles)
Flexion of MCPJ of digits 2 – 5	Lumbricals (flexor digitorum superficialis, flexor digitorum profundus, flexor digiti minimi, interossei)
Flexion of PIPJ of digits 2 – 5	Flexor digitorum superficialis (flexor digitorum profundus)
Flexion of DIPJ of digits 2 – 5	Flexor digitorum profundus
Extension of MCPJ of digits 2 – 5	Extensor digitorum, extensor indicis, extensor digiti minimi
Extension of PIPJ and DIPJ of digits 2 – 5	Lumbricals and interossei (extensor digitorum)
Adduction of digits 2 – 5	Palmar interossei
Abduction of digits 2 – 4	Dorsal interossei
Abduction of little finger	Abductor digiti minimi
Opposition of little finger	Opponens digiti minimi

Thumb movements	Primary muscle(s)
Flexion of thumb at MCPJ	Flexor pollicis longus and brevis
Flexion of thumb at IPJ	Flexor pollicis longus
Extension of thumb at CMCJ and MCPJ	Extensor pollicis longus and brevis
Extension of thumb at IPJ	Extensor pollicis longus
Abduction of thumb	Abductor pollicis longus and brevis
Adduction of thumb	Adductor pollicis
Opposition of thumb	Opponens pollicis



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Anatomy: Forearm and Hand



Question 74 of 102

A 54 year old man presents to the ED after tripping on a kerb. He tells you he fell onto his outstretched right hand. He complains of pain in his right wrist and on examination you note anatomical snuffbox tenderness. Which of the following structures passes through the anatomical snuffbox:

a Median nerve

b Ulnar nerve

c Radial artery

d Basilic vein

e Palmaris longus tendon

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Anatomy: Forearm and Hand

Question 74 of 102

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a) Median nerve
b) Ulnar nerve
c) **Radial artery** ✔
d) Basilic vein
e) Palmaris longus tendon

Answer

The radial artery crosses the floor of the anatomical snuffbox lying deep to the extensor tendons of the thumb and adjacent to the scaphoid and trapezium bones. The other structures listed do not pass through the anatomical snuffbox.

Notes

The anatomical snuffbox is the triangular depression formed on the posterolateral side of the dorsal wrist and 1st metacarpal by the extensor tendons passing into the thumb.

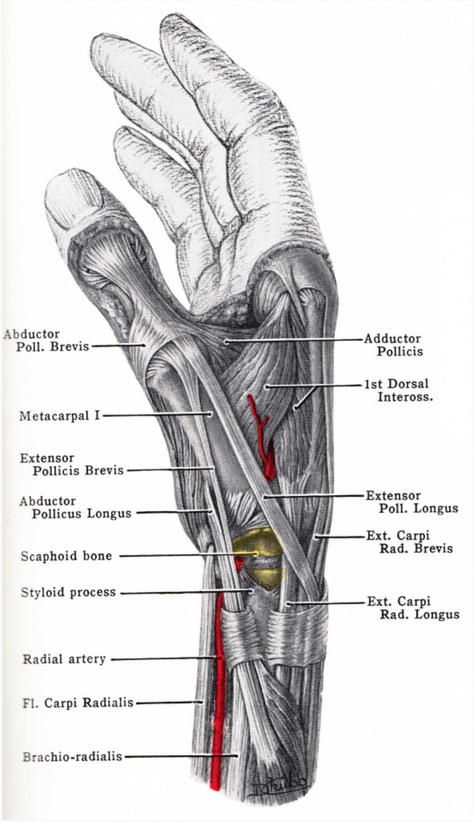
Anatomical Boundaries	Structure
Medial border	Tendon of extensor pollicis longus
Lateral border	Tendons of the abductor pollicis longus and extensor pollicis brevis
Proximal border	Radial styloid process
Distal border	1st metacarpal
Floor	Scaphoid and trapezium bones
Roof	Skin
Contents	Radial artery, terminal portion of the superficial branch of the radial nerve, cephalic vein

It is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis and medially by the tendon of the extensor pollicis longus.

The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

The radial artery crosses the floor of the anatomical snuffbox. Subcutaneously terminal parts of the superficial branch of the radial nerve and the origin of the cephalic vein pass over the anatomical snuffbox.

The anatomical snuffbox is important clinically as the scaphoid is palpable within the snuffbox; localised pain and tenderness of the anatomical snuffbox is most likely due to a scaphoid fracture.



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Anatomy: Forearm and Hand



Question 75 of 102

A 26 year old woman presents complaining of numbness in her right hand. On examination she has no sensation to the skin over the lateral half of the palm. This area is supplied by which of the following nerves:

a The superficial branch of the radial nerve

b The palmar cutaneous branch of the median nerve

c The palmar cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The palmar digital branch of the median nerve

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Question 75 of 102

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a) The superficial branch of the radial nerve
b) **The palmar cutaneous branch of the median nerve** ✔
c) The palmar cutaneous branch of the ulnar nerve
d) The superficial branch of the ulnar nerve
e) The palmar digital branch of the median nerve

Answer

The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

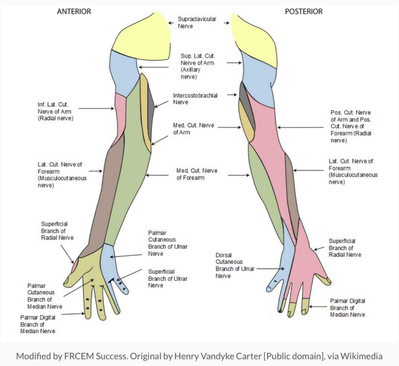
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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Anatomy: Forearm and Hand



Question 76 of 102

A 48 year old man presents to ED having sustained a superficial laceration to his wrist on broken glass. Which of the following structures passing superficial to the flexor retinaculum may be damaged in this injury:

a Median and ulnar nerve

b Median nerve and tendon of the flexor digitorum superficialis

c Ulnar artery and ulnar nerve

d Ulnar nerve and radial artery

e Ulnar nerve and tendon of the flexor digitorum superficialis

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Anatomy: Forearm and Hand

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A 48 year old man presents to ED having sustained a superficial laceration to his wrist on broken glass. Which of the following structures passing superficial to the flexor retinaculum may be damaged in this injury:

a) Median and ulnar nerve
b) Median nerve and tendon of the flexor digitorum superficialis
c) **Ulnar artery and ulnar nerve** ✔
d) Ulnar nerve and radial artery
e) Ulnar nerve and tendon of the flexor digitorum superficialis

Answer

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum. The median nerve and the flexor tendons pass into the hand deep to the flexor retinaculum, within the carpal tunnel.

Notes

The flexor retinaculum (transverse carpal ligament) is a thickened band of fibrous connective tissue on the volar aspect of the hand which forms the roof of the carpal tunnel. The flexor retinaculum holds the flexor tendons in place at the wrist and prevents them from bowstringing.

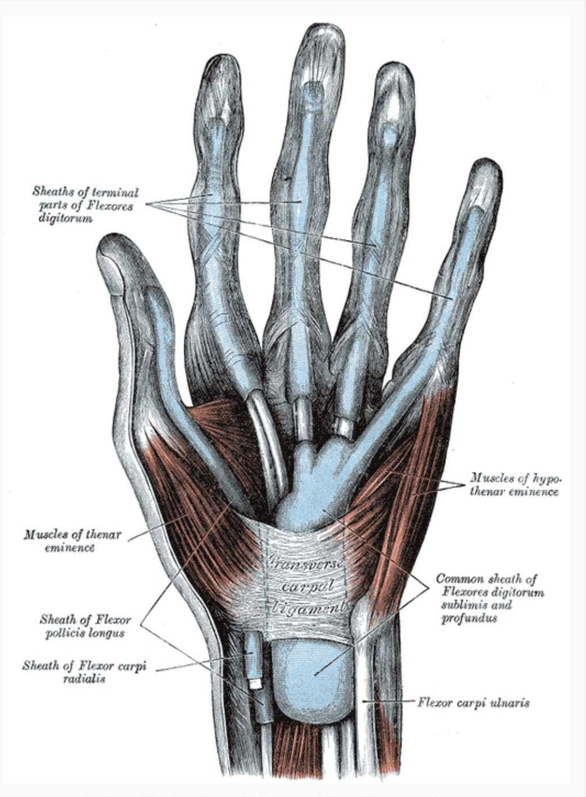
It is attached laterally to the scaphoid and trapezium and medially to the pisiform and the hook of the hamate.

The thenar and hypothenar muscles arise from the flexor retinaculum.

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

The flexor carpi radialis tendon passes through the lateral aspect of the flexor retinaculum into the hand.

The four tendons of the flexor digitorum profundus, the four tendons of the flexor digitorum superficialis, the tendon of the flexor pollicis longus and the median nerve pass into the hand posterior to the flexor retinaculum, within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 77 of 102

Regarding the distal attachments of the posterior forearm muscle tendons, which of the following is paired CORRECTLY:

a Abductor pollicis longus – Base of proximal phalanx of thumb

b Extensor pollicis brevis – Base of distal phalanx of thumb

c Extensor carpi radialis longus – Base of 1st metacarpal

d Extensor carpi ulnaris – Base of 5th metacarpal

e Extensor digitorum – Bases of 2nd – 4th metacarpals

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Question 77 of 102

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a) Abductor pollicis longus – Base of proximal phalanx of thumb
b) Extensor pollicis brevis – Base of distal phalanx of thumb
c) Extensor carpi radialis longus – Base of 1st metacarpal
d) **Extensor carpi ulnaris – Base of 5th metacarpal** ✔
e) Extensor digitorum – Bases of 2nd – 4th metacarpals

Answer

The extensor carpi ulnaris tendon is attached to the base of the 5th metacarpal. The abductor pollicis longus is attached distally to the lateral side of base of the 1st metacarpal. The extensor digitorum is attached to the base of the middle and distal phalanges of digits 2 – 5 via extensor hoods. The extensor pollicis brevis is attached to the proximal phalanx of the thumb. The extensor carpi radialis longus is attached to the base of the 2nd metacarpal.

Notes

The muscles of the posterior forearm are all innervated by the radial nerve.

The posterior forearm is divided into the superficial and deep groups:

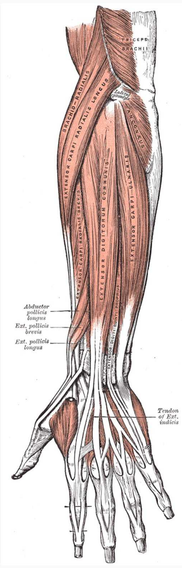
- The superficial group is made up of the brachioradialis, the extensor carpi radialis longus and brevis, the extensor digitorum, the extensor digiti mini, the anconeus and the extensor carpi ulnaris.
- The deep group is made up of the supinator, the abductor pollicis longus, the extensor pollicis longus and brevis and the extensor indicis.

Muscle	Action	Innervation
Brachioradialis	Flexion of elbow	Radial nerve
Extensor carpi radialis longus	Extension and abduction of wrist	Radial nerve
Extensor carpi radialis brevis	Extension and abduction of wrist	Radial nerve
Extensor digitorum	Extension of all four fingers, extension of wrist	Radial nerve
Extensor digiti minimi	Extension of little finger	Radial nerve
Extensor carpi ulnaris	Extension and adduction of wrist	Radial nerve
Supinator	Supination of forearm	Radial nerve
Abductor pollicis longus	Abduction and extension of thumb	Radial nerve
Extensor pollicis longus	Extension of thumb (CMCJ, MCPJ, IPJ)	Radial nerve
Extensor pollicis brevis	Extension of thumb (CMCJ and MCPJ)	Radial nerve
Extensor indicis	Extension of index finger	Radial nerve

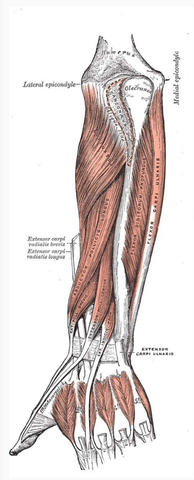
A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The abductor pollicis longus is attached distally to the lateral side of base of the 1st metacarpal.
- The extensor pollicis brevis is attached to the proximal phalanx of the thumb and the extensor pollicis longus is attached to the distal phalanx of the thumb.
- The extensor carpi radialis longus is attached to the base of the 2nd metacarpal and the extensor carpi radialis brevis is attached to the bases of the 2nd and 3rd metacarpals.
- The extensor digitorum is attached to the base of the middle and distal phalanges of digits 2 – 5 via extensor hoods.
- The extensor carpi ulnaris is attached to the base of the 5th metacarpal.
- The extensor digiti minimi is attached to the base of the 5th metacarpal.
- The extensor indicis is attached to the extensor hood of the index finger.

Muscle tendon	Distal attachment
Extensor carpi radialis longus	Dorsal surface of base of 2nd metacarpal
Extensor carpi radialis brevis	Dorsal surface of base of 2nd and 3rd metacarpal
Extensor digitorum	Dorsal aspects of bases of middle and distal phalanges of all four fingers via extensor hoods
Extensor carpi ulnaris	Tubercle on base of medial 5th metacarpal
Abductor pollicis longus	Lateral side of base of 1st metacarpal
Extensor pollicis longus	Dorsal surface of base of distal phalanx of thumb
Extensor pollicis brevis	Dorsal surface of base of proximal phalanx of thumb
Extensor indicis	Extensor hood of index finger



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Anatomy: Forearm and Hand



Question 78 of 102

A 32 year old farmer sustained a puncture wound to the base of the thumb. The wound became infected and the infection spread to the midpalmar space. The tendon(s) of which muscle will most likely be affected:

a Flexor digitorum profundus

b Flexor pollicis brevis

c Flexor pollicis longus

d Flexor digitorum superficialis

e Flexor carpi radialis

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a) Flexor digitorum profundus
b) Flexor pollicis brevis
c) **Flexor pollicis longus** ✔
d) Flexor digitorum superficialis
e) Flexor carpi radialis

Answer

Tenosynovitis in the thumb may spread through the synovial sheath of the flexor pollicis longus tendon, also known as the radial bursa.

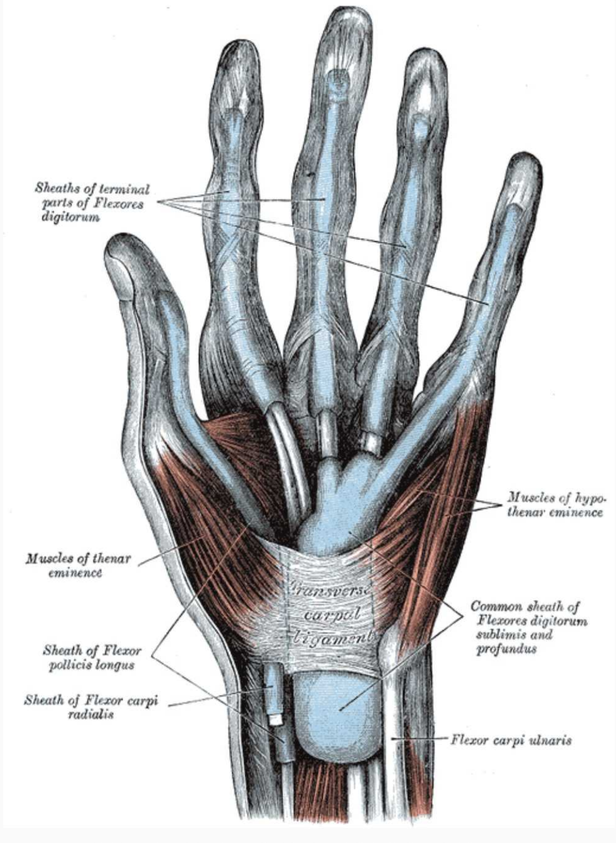
Notes

Tenosynovitis can be due to an infection of the synovial sheaths of the digits. Infections may occur in the digital synovial sheath for example after a puncture wound to a finger.

Infection in the middle three fingers is usually contained as they have separate synovial sheaths.

The synovial sheath of the little finger is usually continuous with the common flexor sheath (the ulnar bursa) and thus infection may spread to this sheath and from here to the midpalmar space.

Infections in the thumb may spread to the midpalmar space via the continuous synovial sheath of the flexor pollicis longus, also known as the radial bursa.



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A 48 year old presents to ED having sustained a deep laceration to his right upper limb. On examination he is unable to extend the interphalangeal joints of the fourth and fifth digits and extension of the interphalangeal joints of the second and third digits is very weak. Extension at the metacarpophalangeal joints is preserved in all digits. Which of the following nerves has most likely been injured:

a Superficial branch of the ulnar nerve

b Deep branch of the ulnar nerve

c Anterior interosseous nerve

d Posterior interosseous nerve

e Recurrent branch of the median nerve

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a) Superficial branch of the ulnar nerve
b) **Deep branch of the ulnar nerve** ✔
c) Anterior interosseous nerve
d) Posterior interosseous nerve
e) Recurrent branch of the median nerve

Answer

The deep branch of the ulnar nerve innervates the medial two lumbricals and all of the interossei. There is loss of extension at the IPJs of the fourth and fifth digits due to paralysis of the medial two lumbricals and the interossei. Extension at the IPJs of the second and third digits are only weakened as the lateral two lumbricals are spared (innervated by the median nerve). Extension at the MCPJs of all five digits is a function of the radial nerve. The superficial branch of the ulnar nerve has only cutaneous function.

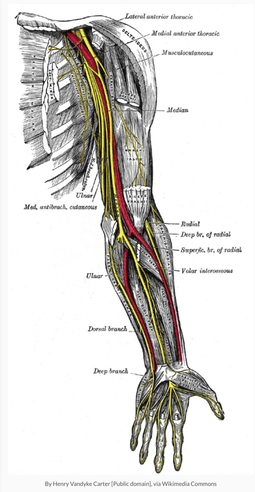
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb abduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 80 of 102

A 21 year old patient sustains a laceration which transects the flexor retinaculum. Regarding the flexor retinaculum, which of the following statements is INCORRECT:

a The flexor retinaculum forms the roof of the carpal tunnel.

b The thenar and hypothenar muscles arise from the flexor retinaculum.

c The ulnar artery passes into the hand anterior to the flexor retinaculum.

d The tendons of the flexor pollicis longus, flexor digitorum profundus and flexor digitorum superficialis pass into the hand posterior to the flexor retinaculum.

e The ulnar nerve and the median nerve pass into the hand posterior to the flexor retinaculum.

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Anatomy: Forearm and Hand

Question 80 of 102

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a) The flexor retinaculum forms the roof of the carpal tunnel.

b) The thenar and hypothenar muscles arise from the flexor retinaculum.

c) The ulnar artery passes into the hand anterior to the flexor retinaculum.

d)
The tendons of the flexor pollicis longus, flexor digitorum profundus and flexor digitorum superficialis pass into the hand posterior to the flexor retinaculum.

e)
The ulnar nerve and the median nerve pass into the hand posterior to the flexor retinaculum.

Answer

The median nerve passes into the hand posterior to the flexor retinaculum, within the carpal tunnel, but the ulnar nerve passes into the hand anterior to the flexor retinaculum.

Notes

The flexor retinaculum (transverse carpal ligament) is a thickened band of fibrous connective tissue on the volar aspect of the hand which forms the roof of the carpal tunnel. The flexor retinaculum holds the flexor tendons in place at the wrist and prevents them from bowstringing.

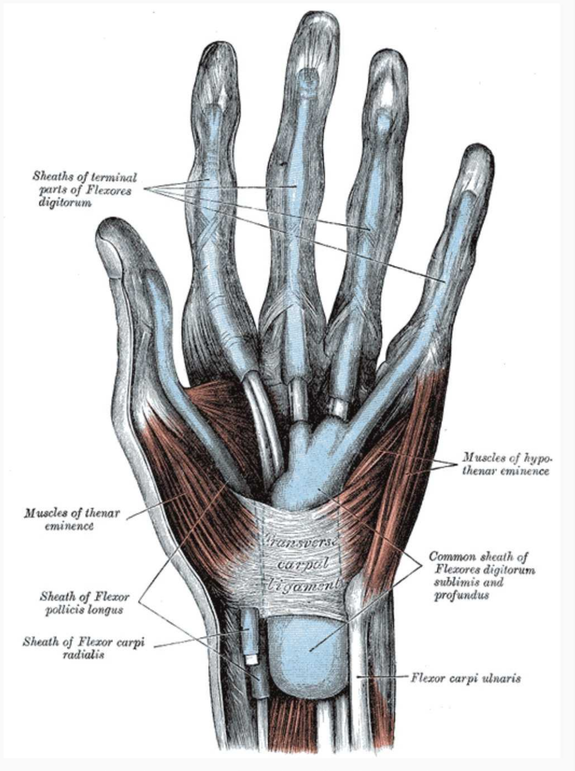
It is attached laterally to the scaphoid and trapezium and medially to the pisiform and the hook of the hamate.

The thenar and hypothenar muscles arise from the flexor retinaculum.

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

The flexor carpi radialis tendon passes through the lateral aspect of the flexor retinaculum into the hand.

The four tendons of the flexor digitorum profundus, the four tendons of the flexor digitorum superficialis, the tendon of the flexor pollicis longus and the median nerve pass into the hand posterior to the flexor retinaculum, within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 81 of 102

You have been asked to review a patient with a Monteggia fracture. The proximal radioulnar joint is primarily supported by which of the following ligaments:

a Ulnar collateral ligament

b Radial collateral ligament

c Annular ligament

d Deltoid ligament

e Transverse humeral ligament

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Question 81 of 102

You have been asked to review a patient with a Monteggia fracture. The proximal radioulnar joint is primarily supported by which of the following ligaments:

a) Ulnar collateral ligament
b) Radial collateral ligament
c) **Annular ligament** ✔
d) Deltoid ligament
e) Transverse humeral ligament

Answer

The proximal radioulnar joint is a pivot type synovial joint occurring between the head of the radius and the radial notch of the ulnar. The radial head is held in position by the annular ligament of the radius. The radial and ulnar collateral ligaments support the elbow joint. The transverse humeral ligament spans the intertubercular sulcus of the proximal humerus. The deltoid ligament supports the ankle joint.

Notes

The radioulnar joints allow pronation and supination of the forearm.

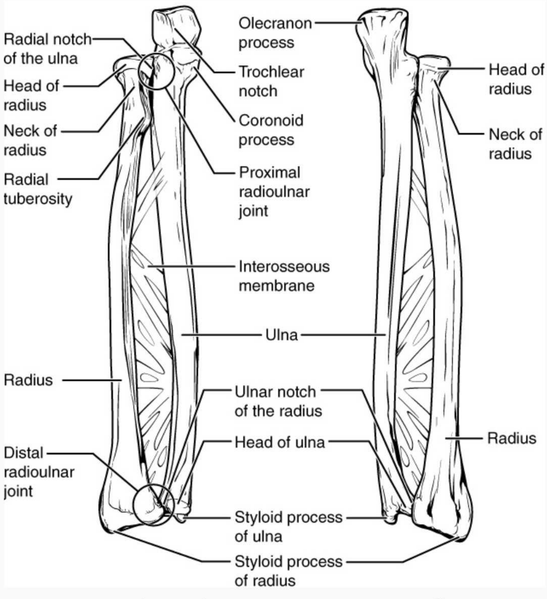
Movement	Muscles Involved
Pronation	Pronator quadratus, pronator teres
Supination	Supinator, biceps brachii

The proximal radioulnar joint is a pivot type synovial joint occurring between the head of the radius and the radial notch of the ulnar. The radial head is held in position by the annular ligament of the radius.

Joint	Proximal radioulnar joint
Type	Synovial pivot
Articulations	Head of radius with radial notch of ulna
Stabilising factors	Annular ligament
Movements	Pronation and supination

The distal radioulnar joint is a pivot type synovial joint occurring between the head of the ulnar and the ulnar notch on the radius.

Joint	Distal radioulnar joint
Type	Synovial pivot
Articulations	Head of ulna with ulnar notch of radius
Movements	Pronation and supination



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Anatomy: Forearm and Hand



Question 82 of 102

A 32 year old farm worker has presented to the ED with an infected laceration on a finger. You are concerned about the possible spread of infection into the midpalmar space. Infections in the digital synovial sheath of which fingers are most likely to spread to the midpalmar space:

a Thumb and index fingers

b Lateral three fingers

c Medial two fingers

d Thumb and little finger

e Index and middle finger

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a) Thumb and index fingers
b) Lateral three fingers
c) Medial two fingers
d) **Thumb and little finger** ✔
e) Index and middle finger

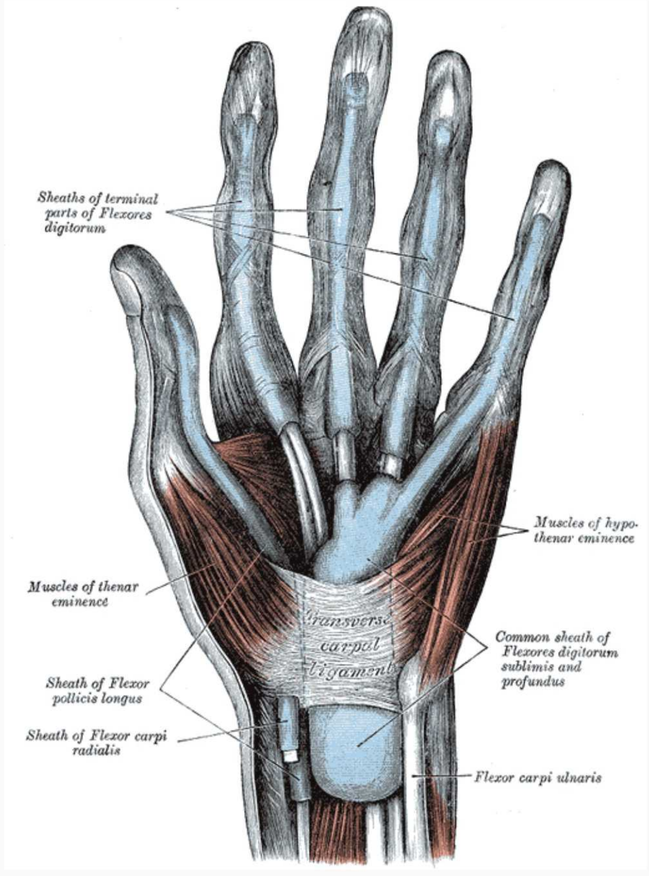
Notes

Infections may occur in the digital synovial sheath for example after a puncture wound of a finger.

Infection in the middle three fingers is usually contained as they have separate synovial sheaths.

The synovial sheath of the little finger is usually continuous with the common flexor sheath and thus infection may spread to this sheath and from here to the midpalmar space.

Infections in the thumb may spread to the midpalmar space via the continuous synovial sheath of the flexor pollicis longus.



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Anatomy: Forearm and Hand



Question 83 of 102

A 29 year old woman is brought to the ED after concerns were raised for her welfare by a neighbour. She has a deep laceration to the anterior aspect of the right wrist. You are concerned about an injury to the underlying structures including the flexor retinaculum. The flexor retinaculum is attached laterally to which of the following structures:

a Scaphoid and radius

b Scaphoid and trapezium

c Scaphoid and trapezoid

d Trapezium and trapezoid

e Radius and scaphoid

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a) Scaphoid and radius
b) **Scaphoid and trapezium** ✔
c) Scaphoid and trapezoid
d) Trapezium and trapezoid
e) Radius and scaphoid

Answer

The flexor retinaculum is attached laterally to the scaphoid and trapezium.

Notes

The flexor retinaculum (transverse carpal ligament) is a thickened band of fibrous connective tissue on the volar aspect of the hand which forms the roof of the carpal tunnel. The flexor retinaculum holds the flexor tendons in place at the wrist and prevents them from bowstringing.

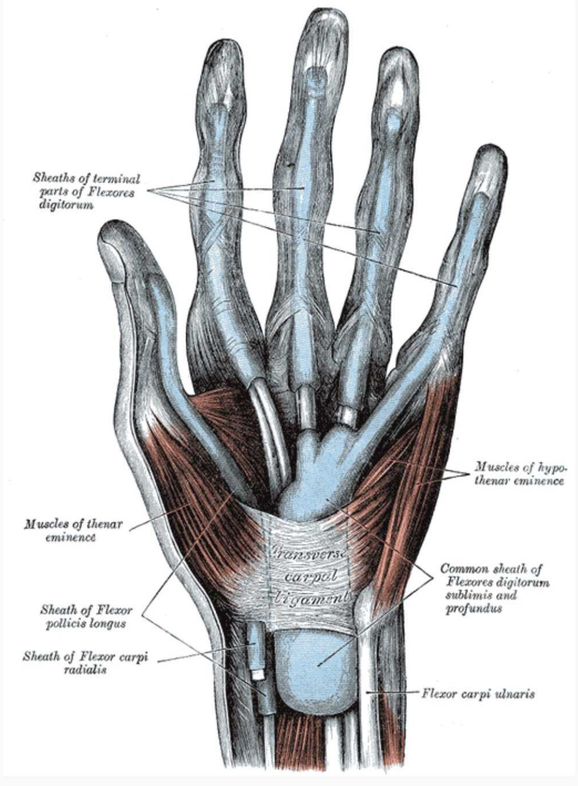
It is attached laterally to the scaphoid and trapezium and medially to the pisiform and the hook of the hamate.

The thenar and hypothenar muscles arise from the flexor retinaculum.

The ulnar artery, ulnar nerve, and tendon of the palmaris longus pass into the hand anterior to the flexor retinaculum, and therefore do not pass through the carpal tunnel.

The flexor carpi radialis tendon passes through the lateral aspect of the flexor retinaculum into the hand.

The four tendons of the flexor digitorum profundus, the four tendons of the flexor digitorum superficialis, the tendon of the flexor pollicis longus and the median nerve pass into the hand posterior to the flexor retinaculum, within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 84 of 102

A 19 year old male attends ED having sustained a stab wound to his upper limb. On examination, the patient is unable to flex the distal interphalangeal joints of the ring and little finger but the proximal interphalangeal joint is intact. Which of the following nerves is most likely affected, and at which level:

a Median nerve at elbow

b Median nerve at wrist

c Ulnar nerve at elbow

d Ulnar nerve at wrist

e Median nerve in proximal forearm

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Question 84 of 102

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a) Median nerve at elbow
b) Median nerve at wrist
c) **Ulnar nerve at elbow** ✔
d) Ulnar nerve at wrist
e) Median nerve in proximal forearm

Answer

Loss of flexion at the distal interphalangeal joint of the ring and index finger is likely due to paralysis of the medial half of the flexor digitorum profundus, innervated by the ulnar nerve. Flexion at the proximal interphalangeal joint is preserved as this is a function of the flexor digitorum superficialis, innervated by the median nerve. Ulnar nerve injury at the wrist would not affect the long flexors, so the injury must have been more proximal.

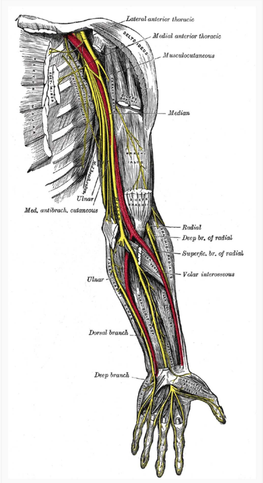
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

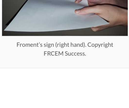
Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



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Anatomy: Forearm and Hand



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A 35 year old man attends ED having been thrown off his mountain bike and fallen onto his right arm. You note numerous abrasions and bruises. He is unable to extend his right wrist, fingers and thumb, although can extend his elbow. Sensation is abnormal on the lateral dorsum of his right hand. Which of the following nerves has most likely been affected, and at which level:

a Radial nerve, axilla

b Median nerve, arm

c Radial nerve, midhumerus

d Superficial branch of radial nerve, forearm

e Ulnar nerve, forearm

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a) Radial nerve, axilla
b) Median nerve, arm
c) **Radial nerve, midhumerus** ✔
d) Superficial branch of radial nerve, forearm
e) Ulnar nerve, forearm

Answer

The radial nerve innervates the posterior muscles in the arm and forearm, which primarily act to produce extension of the forearm, wrist and fingers. In injury to the radial nerve in the axilla, you would expect the triceps brachii muscle to also be affected, and thus extension at the elbow to be lost in association with loss of sensation over the inferior lateral arm and posterior arm and forearm. In injury at the mid-humerus the triceps brachii muscle and the cutaneous branches of the arm and forearm are usually spared. The superficial branch of the radial nerve has no motor supply and thus cannot solely be affected in this case.

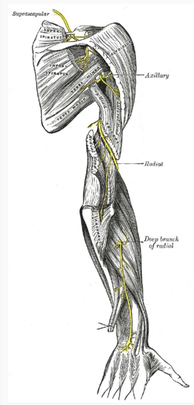
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 86 of 102

A patient sustains an injury to the proximal median nerve after falling through a glass door. Which of the following muscles would you not expect to be affected:

a Flexor carpi ulnaris

b Flexor carpi radialis

c Flexor digitorum superficialis

d Flexor digitorum profundus

e Flexor pollicis longus

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A patient sustains an injury to the proximal median nerve after falling through a glass door. Which of the following muscles would you not expect to be affected:

a) **Flexor carpi ulnaris** ✔
b) Flexor carpi radialis
c) Flexor digitorum superficialis
d) Flexor digitorum profundus
e) Flexor pollicis longus

Answer

All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

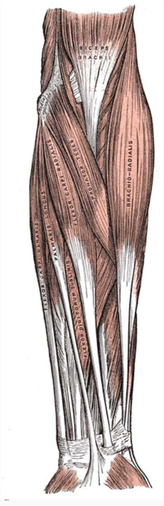
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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A 17 year old footballer sustains an injury to the proximal ulnar nerve after fracturing his elbow. Which of the following muscles would you least expect to be affected:

a Medial two lumbricals

b Interossei muscles

c Flexor digitorum superficialis

d Flexor digitorum profundus

e Adductor pollicis

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A 17 year old footballer sustains an injury to the proximal ulnar nerve after fracturing his elbow. Which of the following muscles would you least expect to be affected:

a) Medial two lumbricals
b) Interossei muscles
c) **Flexor digitorum superficialis** ✔
d) Flexor digitorum profundus
e) Adductor pollicis

Answer

The flexor digitorum superficialis is innervated by the median nerve, together with the lateral half of the flexor digitorum profundus.

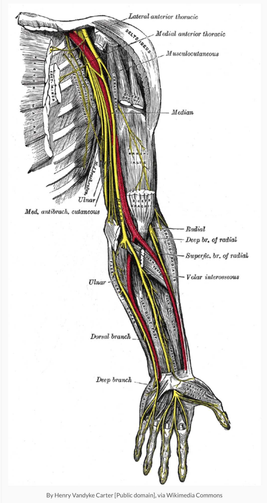
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 88 of 102

A 67 year old woman presents to the ED after falling onto an outstretched hand. You x-ray her left wrist and note no fracture. You discuss the case with your consultant, he advises you to test for anatomical snuffbox tenderness. The anatomical snuffbox is bounded laterally by the tendons of which of the following muscles:

a Abductor pollicis brevis and extensor pollicis longus

b Extensor pollicis longus and extensor pollicis brevis

c Abductor pollicis longus and extensor pollicis brevis

d Abductor pollicis longus and extensor pollicis longus

e Abductor pollicis brevis and extensor pollicis brevis

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a) Abductor pollicis brevis and extensor pollicis longus
b) Extensor pollicis longus and extensor pollicis brevis
c) **Abductor pollicis longus and extensor pollicis brevis** ✔
d) Abductor pollicis longus and extensor pollicis longus
e) Abductor pollicis brevis and extensor pollicis brevis

Answer

The anatomical snuffbox is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis.

Notes

The anatomical snuffbox is the triangular depression formed on the posterolateral side of the dorsal wrist and 1st metacarpal by the extensor tendons passing into the thumb.

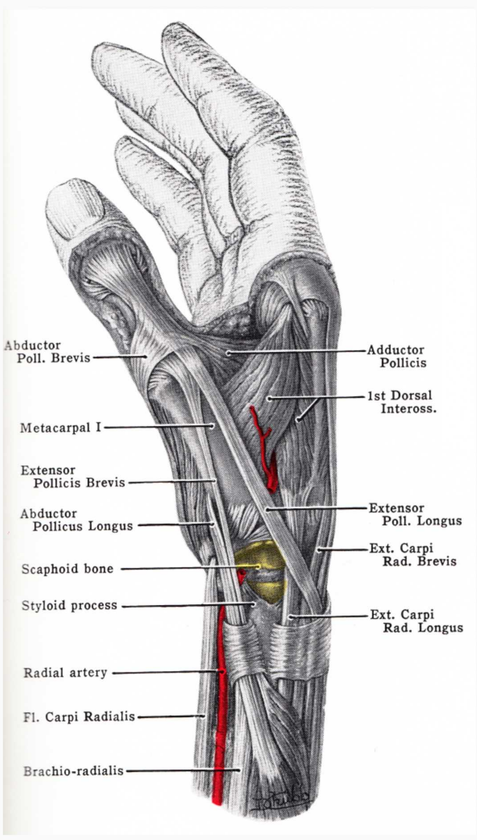
Anatomical Boundaries	Structure
Medial border	Tendon of extensor pollicis longus
Lateral border	Tendons of the abductor pollicis longus and extensor pollicis brevis
Proximal border	Radial styloid process
Distal border	1st metacarpal
Floor	Scaphoid and trapezium bones
Roof	Skin
Contents	Radial artery, terminal portion of the superficial branch of the radial nerve, cephalic vein

It is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis and medially by the tendon of the extensor pollicis longus.

The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

The radial artery crosses the floor of the anatomical snuffbox. Subcutaneously terminal parts of the superficial branch of the radial nerve and the origin of the cephalic vein pass over the anatomical snuffbox.

The anatomical snuffbox is important clinically as the scaphoid is palpable within the snuffbox; localised pain and tenderness of the anatomical snuffbox is most likely due to a scaphoid fracture.



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A 27 year old woman sustains an injury to the proximal median nerve after cutting herself whilst separating frozen chicken breasts using a knife. Which of the following muscles would you not expect to be affected:

a Opponens pollicis

b Abductor pollicis brevis

c Flexor pollicis brevis

d Adductor pollicis

e Flexor pollicis longus

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a) Opponens pollicis
b) Abductor pollicis brevis
c) Flexor pollicis brevis
d) **Adductor pollicis** ✔
e) Flexor pollicis longus

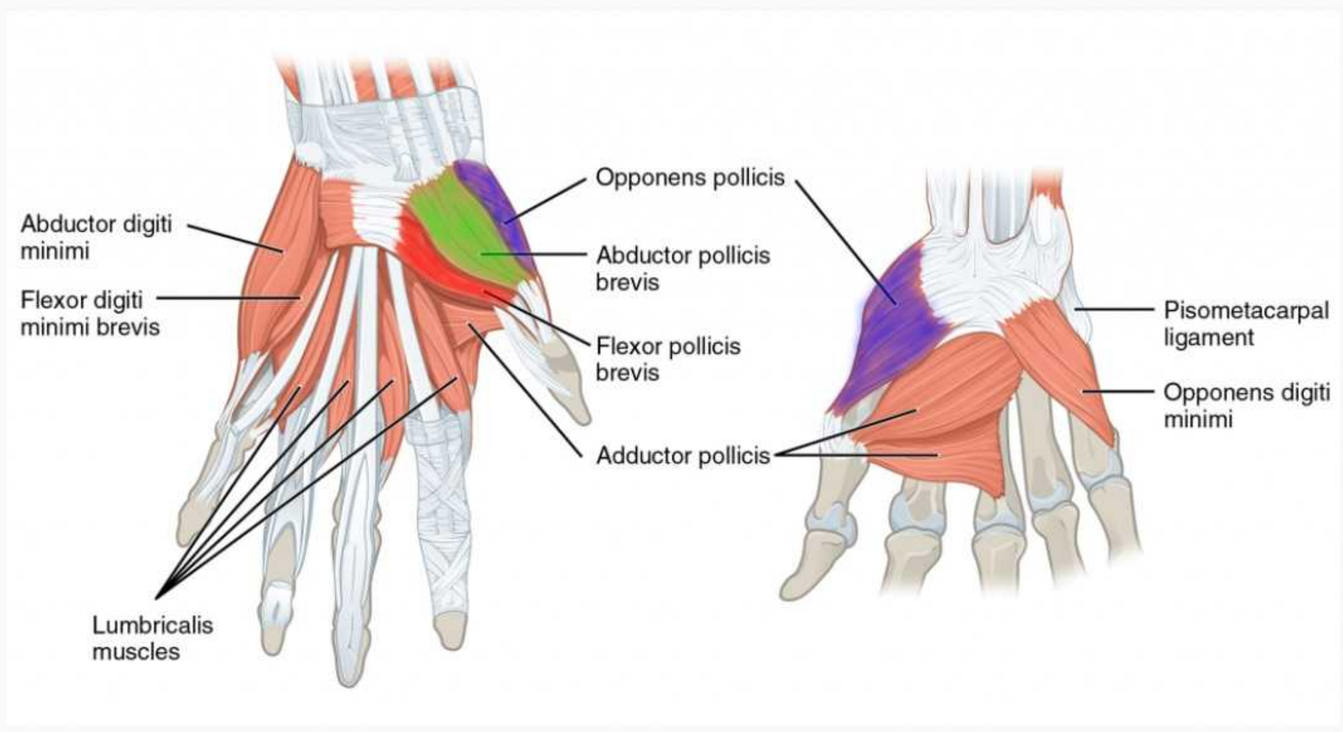
Answer

The thenar muscles (opponens pollicis, abductor pollicis brevis and flexor pollicis brevis) are all innervated by the median nerve. The flexor pollicis longus in the anterior forearm is also innervated by the median nerve. The adductor pollicis, an intrinsic hand muscle, is innervated by the ulnar nerve. The muscles of the hand supplied by the median nerve can be remembered using the mnemonic, "LOAF" for Lumbricals 1 & 2, Opponens pollicis, Abductor pollicis brevis and Flexor pollicis brevis.

Notes

The thenar eminence consists of the opponens pollicis, the abductor pollicis brevis and the flexor pollicis brevis. The thenar muscles are all innervated by the median nerve.

Muscle	Action	Innervation
Opponens pollicis (blue)	Medially rotates thumb	Median nerve
Abductor pollicis brevis (green)	Abducts thumb at MCPJ	Median nerve
Flexor pollicis brevis (red)	Flexes thumb at MCPJ	Median nerve



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A 32 year old electrician presents to the ED after sustaining a laceration to the forearm. On examination of the hand you note loss of sensation to the lateral dorsal surface. The skin over the lateral dorsum of the hand and the dorsum of the lateral three and a half digits is supplied by which of the following nerves:

a The superficial branch of the radial nerve

b The deep branch of the radial nerve

c The dorsal cutaneous branch of the ulnar nerve

d The superficial branch of the ulnar nerve

e The digital branch of the median nerve

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a) The superficial branch of the radial nerve ✔
b) The deep branch of the radial nerve
c) The dorsal cutaneous branch of the ulnar nerve
d) The superficial branch of the ulnar nerve
e) The digital branch of the median nerve

Answer

The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.

Notes

Nerve	Origin	Skin supplied
Lateral supraclavicular nerve	Cervical plexus (C3, C4)	Upper half of deltoid muscle
Superior lateral cutaneous nerve of the arm	Axillary nerve	Lower half of deltoid muscle
Inferior lateral cutaneous nerve of the arm	Radial nerve	Lateral arm below deltoid muscle
Medial cutaneous nerve of the arm	Brachial plexus (C8, T1)	Medial arm
Intercostobrachial nerve	Second intercostal nerve (T2)	Axilla
Posterior cutaneous nerve of the arm	Radial nerve	Posterior arm
Medial cutaneous nerve of the forearm	Brachial plexus (C8, T1)	Medial forearm
Posterior cutaneous nerve of the forearm	Radial nerve	Posterior forearm
Lateral cutaneous nerve of the forearm	Musculocutaneous nerve	Lateral forearm
Superficial branch of radial nerve	Radial nerve	Lateral dorsum of hand and lateral three and a half digits
Palmar cutaneous branch of ulnar nerve	Ulnar nerve	Medial half of palm
Dorsal cutaneous branch of ulnar nerve	Ulnar nerve	Medial dorsum of hand and medial one and a half fingers
Superficial branch of ulnar nerve	Ulnar nerve	Palmar surface of medial one and a half digits
Palmar cutaneous branch of median nerve	Median nerve	Lateral half of palm
Palmar digital branch of median nerve	Median nerve	Palmar surface and fingertips of lateral three and a half digits

Arm:

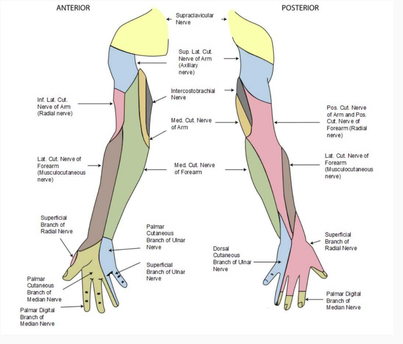
- The lateral supraclavicular nerve, branch of the cervical plexus, supplies the skin over the upper half of the deltoid muscle.
- The superior lateral cutaneous nerve of the arm, branch of the axillary nerve, supplies the skin over the lower half of the deltoid muscle (regimental badge area).
- The inferior lateral cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the lateral side of the arm below the deltoid muscle.
- The medial cutaneous nerve of the arm, branch of the brachial plexus, supplies skin over the medial arm.
- The intercostobrachial nerve, branch of the second intercostal nerve, supplies the skin of the axilla.
- The posterior cutaneous nerve of the arm, branch of the radial nerve, supplies the skin over the posterior arm.

Forearm:

- The medial cutaneous nerve of the forearm, branch of the brachial plexus, supplies the skin over the medial aspect of the forearm.
- The posterior cutaneous nerve of the forearm, branch of the radial nerve, supplies the skin over the posterior forearm.
- The lateral cutaneous nerve of the forearm, branch of the musculocutaneous nerve, supplies the skin over the lateral aspect of the forearm.

Hand:

- The superficial branch of the radial nerve supplies the skin over the lateral dorsum of the hand and the lateral three and a half digits.
- The palmar cutaneous branch of the ulnar nerve supplies the skin over the medial half of the palm.
- The dorsal cutaneous branch of the ulnar nerve supplies the skin over medial dorsum of the hand and the dorsum of the medial one and a half fingers.
- The superficial branch of the ulnar nerve supplies the skin over the palmar surface of the medial one and a half fingers.
- The palmar cutaneous branch of the median nerve supplies the skin over the lateral half of the palm.
- The palmar digital branch of the median nerve supplies the skin over the palmar surface and the fingertips of the lateral three and a half digits.



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A 32 year old man sustains an injury to the proximal radial nerve after falling from a ladder. Which of the following muscles would you not expect to be affected:

a Brachioradialis

b Supinator

c Abductor pollicis longus

d Extensor digiti minimi

e Pronator quadratus

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Anatomy: Forearm and Hand



Question 92 of 102

You are examining the arm of a 23 year old electrician who has sustained a fracture of the humerus following a fall. On examination he finds flexion of the wrist painful. The flexor muscles of the anterior forearm all originate from which of the following structures:

a The medial epicondyle of the humerus

b The lateral epicondyle of the humerus

c The lesser trochanter of the humerus

d The greater trochanter of the humerus

e The intertubercular groove of the humerus

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Anatomy: Forearm and Hand

Question 92 of 102

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a) The medial epicondyle of the humerus ✔
b) The lateral epicondyle of the humerus
c) The lesser trochanter of the humerus
d) The greater trochanter of the humerus
e) The intertubercular groove of the humerus

Answer

All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Notes

The anterior forearm is divided into:

- The superficial compartment consisting of the flexor carpi ulnaris, flexor carpi radialis, palmaris longus and the pronator teres
- The intermediate compartment consisting of the flexor digitorum superficialis
- The deep compartment consisting of the flexor digitorum profundus, flexor pollicis longus and pronator quadratus

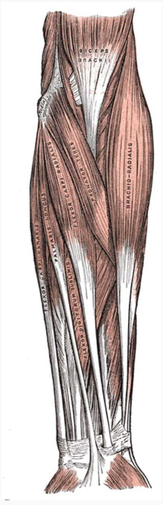
All of the muscles in the anterior forearm are innervated by the median nerve, except for the flexor carpi ulnaris and the medial half of the flexor digitorum profundus which are innervated by the ulnar nerve.

Muscle	Action	Innervation
Flexor carpi ulnaris	Flexion and adduction of wrist	Ulnar nerve
Flexor carpi radialis	Flexion and abduction of wrist	Median nerve
Palmaris longus	Flexion of wrist	Median nerve
Pronator teres	Pronation of forearm	Median nerve
Flexor digitorum superficialis	Flexion of MCPJ and PIPJ of all four digits, flexion of wrist	Median nerve
Flexor pollicis longus	Flexion of MCPJ and IPJ of thumb	Median nerve
Flexor digitorum profundus	Flexion of MCPJ and DIPJ of all four digits, flexion of wrist	Lateral half by median nerve, medial half by ulnar nerve
Pronator quadratus	Pronation of forearm	Median nerve

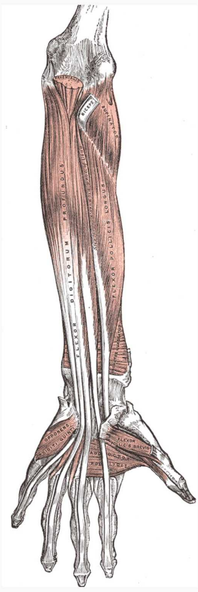
The flexor muscles of the anterior forearm all originate from the medial humeral epicondyle. A detailed knowledge of the distal attachments of the flexor tendons is important to allow understanding of the clinical effects of division/injury at any given level of the finger.

- The flexor pollicis longus is attached distally to the base of the distal phalanx of the thumb.
- The flexor digitorum profundus is attached distally to the palmar surface of the distal phalanges of all four fingers.
- The flexor digitorum superficialis is attached distally to the palmar surface of the middle phalanges of all four fingers.
- The flexor carpi ulnaris is attached distally to the pisiform, hook of hamate and 5th metacarpal.
- The flexor carpi radialis is attached distally to the base of the 2nd and 3rd metacarpal.
- The palmaris longus distally blends with the fibres of the flexor retinaculum which is continuous with the palmar aponeurosis.

Flexor tendon	Distal attachment
Flexor pollicis longus	Base of distal phalanx of thumb
Flexor digitorum profundus	Distal phalanges of all four digits
Flexor digitorum superficialis	Middle phalanges of all four digits
Flexor carpi ulnaris	Pisiform, hook of hamate and 5th metacarpal
Flexor carpi radialis	Base of 2nd and 3rd metacarpal
Palmaris longus	Palmar aponeurosis



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Anatomy: Forearm and Hand



Question 93 of 102

An 18 year old lady has sustained a posterior dislocation of the radius with damage to the deep branch of the radial nerve after falling awkwardly during her routine at a gymnastic competition. Which of the following clinical features would you most expect on examination:

a Inability to abduct the digits at the MCP joint

b Inability to adduct the digits at the MCP joint

c Inability to extend the digits at the MCP joint

d Inability to extend the digits at the MCP, DIP and PIP joints

e Inability to extend the digits and at the PIP and DIP joints

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Anatomy: Forearm and Hand

Question 93 of 102

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a) Inability to abduct the digits at the MCP joint
b) Inability to adduct the digits at the MCP joint
c) Inability to extend the digits at the MCP joint ✔
d) **Inability to extend the digits at the MCP, DIP and PIP joints** ✘
e) Inability to extend the digits and at the PIP and DIP joints

Answer

The deep branch of the radial nerve innervates the muscles of the posterior forearm. Paralysis of the extensor digitorum, extensor digiti minimi and extensor indicis will result in loss of extension at the MCP joints. Extension at the DIP and PIP joints of the digits is largely performed by the lumbricals and the interossei (and to a much lesser extent assisted by the long extensors). Abduction and adduction at the MCP joints is produced by the interossei. The interossei and medial two lumbricals are innervated by the ulnar nerve and the lateral two lumbricals by the median nerve.

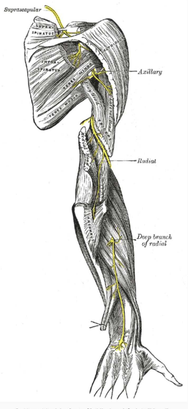
Notes

The radial nerve is a continuation of the posterior cord, containing fibres from C5 – T1.

Nerve	Radial nerve
Nerve roots	C5 – T1
Plexus cords	Posterior cord
Motor Supply	Triceps brachii, posterior compartment of forearm: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Sensory supply	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers

Anatomical course

The radial nerve enters the arm by crossing the lower margin of the teres major muscle, where it lies posterior to the brachial artery. It enters the posterior compartment of the arm, where it descends obliquely passing from medial to lateral in the radial (spiral) groove of the humerus. After emerging from the spiral groove, the radial nerve pierces the lateral intermuscular septum and enters the anterior compartment of the arm, descending into the cubital fossa where it lies between the brachialis and brachioradialis muscles. The radial nerve enters the forearm after passing over the lateral epicondyle of the humerus. Within the proximal forearm the nerve terminates by bifurcating into the deep branch and the superficial branch. N.B. Once the deep branch of the radial nerve penetrates between the two heads of the supinator muscle to access the posterior compartment of the arm, it becomes known as the posterior interosseous nerve.



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Branches

Branches of Radial Nerve	Origin	Supply
Radial nerve	Axilla	Triceps brachii, extensor carpi radialis longus, brachioradialis
Posterior cutaneous nerve of the arm	Axilla	Skin of posterior arm
Inferior lateral cutaneous nerve of the arm	Arm	Skin over lateral aspect of lower arm
Posterior cutaneous nerve of the forearm	Arm	Strip of skin down middle of posterior forearm
Deep branch which continues as the posterior interosseous nerve	Forearm	Posterior compartment of forearm: superficial muscles (extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris) and deep muscles (supinator, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis)
Superficial branch	Forearm	Skin of dorsum of the hand and lateral three and a half fingers

In the arm, the radial nerve directly innervates the triceps brachii, the extensor carpi radialis longus and the brachioradialis. In the forearm, the deep branch, which continues as the posterior interosseous nerve, innervates the muscles of the posterior compartment of the forearm and the superficial branch supplies the skin of the dorsum of the hand and lateral three and a half fingers.

The radial nerve also gives rise to several cutaneous branches; the posterior cutaneous nerve of the arm originating in the axilla, and the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm originating in the arm. These cutaneous branches supply skin over the posterior surface of the arm, the lateral aspect of the arm and the skin down the middle of the posterior forearm respectively.

Clinical implications

Lesion	In axilla	In spiral groove	In forearm (superficial branch)	In forearm (deep branch)
Mechanism	Glenohumeral joint dislocation, fracture of proximal humerus, 'Saturday night syndrome'	Fracture of midshaft of humerus	Stabbing/laceration of forearm	Fracture of radial head or posterior dislocation of radius
Motor Loss	Loss of extension at elbow, wrist and fingers	Loss of extension at wrist and fingers (triceps brachii spared)	None	Weakness of extension at wrist and fingers (extensor carpi radialis spared)
Sensory Loss	Lower lateral arm, posterior arm, posterior forearm, dorsum of lateral hand and three and a half fingers	Dorsum of lateral hand and three and a half fingers (cutaneous branches of arm and forearm spared)	Dorsum of lateral hand and three and a half fingers	None
Signs	Wrist drop (unopposed wrist flexion), weakness of hand grip (finger flexion is weak as the long flexor tendons are not under tension)	Wrist drop, weak hand grip	None	Wrist drop not typically seen (extensor carpi radialis spared)

Radial nerve injury at the axilla may occur in glenohumeral joint dislocation, in fractures of the proximal humerus, through incorrect use of axillary crutches, or due to 'Saturday Night' palsy. There is loss of extension of the forearm due to paralysis of the triceps brachii and loss of extension of the wrist and fingers (predominantly MCPJs, as extension at the IPJs is primarily a function of the lumbrical and interosseous muscles) and weakness of supination due to paralysis of the muscles of the posterior compartment of the forearm. All four cutaneous branches of the radial nerve are affected and there is loss of sensation over the lateral and posterior arm, the posterior forearm and the dorsal surface of the hand and lateral three and a half digits. There is unopposed wrist flexion, giving the appearance of wrist drop.

The radial nerve in the arm is most susceptible to midshaft fractures of the humerus due to its course in the spiral groove. Extension of the forearm is not affected as the triceps brachii is spared. There is loss of extension of the wrist and MCPJs of the fingers and weakness of supination of the forearm. The cutaneous branches of the arm and forearm have already arisen and sensation loss occurs only on the dorsum of the lateral hand and three and a half digits.

Radial nerve damage in the forearm may present as superficial branch or deep branch damage. The superficial branch is most commonly damaged by stabbing or laceration to the forearm and results in loss of sensation over the dorsum of the lateral hand and three and a half digits. The deep branch may be damaged by fracture of the radial head or posterior dislocation of the radius and results in weakness of extension of the wrist and fingers, but not typically with wrist drop (as the extensor carpi radialis is spared).

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Anatomy: Forearm and Hand



Question 94 of 102

Which of the following features would you most expect to see in a patient who has sustained an ulnar nerve injury at the wrist following deliberate self harm:

a Weakness of wrist flexion

b Claw hand appearance

c Loss of abduction of the thumb

d Loss of sensation to the skin over the dorsal and palmar aspect of the medial one and a half digits

e Loss of flexion of the index and ring fingers

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Anatomy: Forearm and Hand

Question 94 of 102

Which of the following features would you most expect to see in a patient who has sustained an ulnar nerve injury at the wrist following deliberate self harm:

a) Weakness of wrist flexion
b) **Claw hand appearance** ✔
c) Loss of abduction of the thumb
d) Loss of sensation to the skin over the dorsal and palmar aspect of the medial one and a half digits
e) Loss of flexion of the index and ring fingers

Answer

Claw hand appearance may be seen in a distal ulnar nerve injury due to unopposed extension at MCPJ and unopposed flexion at IPJ of ring and little finger.

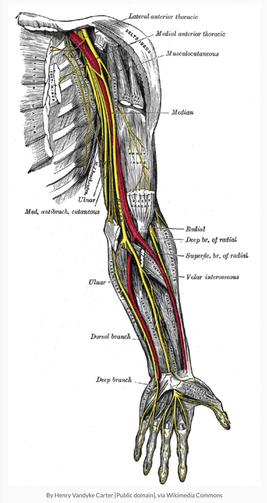
Notes

The ulnar nerve is a continuation of the medial cord of the brachial plexus, containing fibres from the C8 – T1 nerve roots.

Nerve	Ulnar nerve
Nerve roots	C8 – T1
Plexus cords	Medial cord
Motor Supply	All the intrinsic muscles of the hand (except for the thenar muscles and the lateral two lumbricals), the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
Sensory supply	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and lateral dorsum of hand

Anatomical course

The ulnar nerve descends down the medial side of the upper arm and passes posterior to the medial epicondyle (where it is susceptible to damage) before entering the anterior compartment of the forearm by passing between the two heads of the flexor carpi ulnaris. It continues down the medial aspect of the forearm. The ulnar nerve emerges from beneath the flexor carpi ulnaris and becomes superficial just proximal to the wrist where it passes superficial to the flexor retinaculum, together with the ulnar artery, to enter the hand through a groove between the pisiform and the hook of the hamate where it bifurcates into its terminal branches.



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Branches

Branches of Ulnar Nerve	Origin	Supply
Muscular branch	Forearm	Flexor carpi ulnaris, medial half of flexor digitorum profundus
Palmar cutaneous branch	Forearm	Skin of medial half of palm
Dorsal cutaneous branch	Forearm	Skin of dorsum of medial one and a half fingers and associated dorsal hand area
Deep branch	Hand	Hypothenar muscles (abductor digiti minimi, flexor digiti minimi, opponens digiti minimi), medial two lumbricals, adductor pollicis and interossei
Superficial branch	Hand	Skin of palmar surface of medial one and a half fingers

The ulnar nerve gives off no major branches in the arm, but three branches arise in the forearm:

- The muscular branch innervating the flexor carpi ulnaris and the medial half of the flexor digitorum profundus
- The palmar cutaneous branch supplying the skin of the medial half of the palm
- The dorsal cutaneous branch supplying the skin of the medial dorsum of the hand and the dorsal surface of the medial one and a half fingers

The ulnar nerve terminates by bifurcating into:

- A deep branch innervating the hypothenar muscles, the medial two lumbricals, the adductor pollicis and the interossei
- A superficial branch supplying the skin of the palmar surface of the medial one and a half fingers

Clinical implications

Lesion	Proximal (at elbow)	Distal (at wrist)
Mechanism	Fracture of medial epicondyle	Laceration at wrist
Motor Loss	Wrist flexion and adduction, finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension of IPJs of all digits (less so at index and middle finger due to sparing of lateral two lumbricals)	Finger abduction and adduction, flexion of ring and little finger, abduction and opposition of little finger, thumb adduction, extension at IPJs
Sensory Loss	Medial half of palm, palmar and dorsal surface of medial one and a half fingers and medial dorsum of hand	Palmar surface of medial one and a half fingers
Signs	Hand held in abduction (due to unopposed action of flexor carpi radialis), Froment's sign (patient is asked to hold a piece of paper between thumb and flat palm as paper is pulled away, patient will flex thumb at IPJ to maintain hold – tests adductor pollicis muscle), hypothenar eminence wasting, N.B. claw hand not typically seen due to paralysis of the flexor digitorum profundus	Claw hand (unopposed extension at MCPJ and unopposed flexion at IPJs of ring and little finger), hypothenar eminence wasting, Froment's sign

The ulnar nerve is most likely to be injured proximally by a medial epicondyle fracture and results in:

- There is weak wrist flexion and adduction due to paralysis of the flexor carpi ulnaris and the medial half of the flexor digitorum profundus; the hand may be held in abduction (due to unopposed action of the flexor carpi radialis).
- There is loss of abduction and adduction of the fingers due to paralysis of the interossei.
- There is loss of flexion at the MCPJ of the ring and little finger due to paralysis of the medial two lumbricals and the flexor digiti minimi.
- There is loss of flexion at the DIPJ of the ring and little finger due to paralysis of the medial half of the flexor digitorum profundus (but flexion at the PIPJ is likely preserved as this is a function of the flexor digitorum superficialis).
- There is weakened extension at the IPJs of the ring and little finger due to paralysis of the interossei and medial two lumbricals (and to a lesser extent at the IPJs of the index and middle finger).
- There is loss of abduction and opposition of the little finger due to paralysis of the hypothenar muscles (hypothenar wasting may be seen).
- There is loss of adduction of the thumb due to paralysis of the adductor pollicis (Froment's sign).
- There is loss of sensation to skin over the medial half of the palm, the palmar and dorsal surface of the medial one and a half fingers and the medial dorsum of the hand.
- There is not typically a claw hand appearance (as may be seen in a lesion at the wrist) due to paralysis of the flexor digitorum profundus.

A distal lesion most commonly occurs due to laceration at the wrist. Only intrinsic hand muscles are affected (the flexor carpi ulnaris and medial half of the flexor digitorum profundus are spared). A loss of sensation will only affect the palmar surface of the medial one and a half fingers (the medial palm and the dorsum of the hand are spared). A claw hand deformity may be seen due to unopposed extension at the MCPJ (by the extensor digitorum) and unopposed flexion at the IPJs (by the FDP and FDS) of the ring and little finger.



Froment's sign (right hand). Copyright FRCEM Success.



Claw hand deformity. By Mcstrother (Own work) [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

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Anatomy: Forearm and Hand



Question 95 of 102

You have been asked to teach a group of medical students about hand injuries. You cover some anatomical principles including blood supply to the hand. Regarding the palmar arches, which of the following statements is CORRECT:

a The superficial palmar arch lies just deep to the long flexor tendons of the digits.

b Blood supply to the hand is poor, and laceration will usually result in only mild bleeding.

c The deep palmar arch is formed primarily from the ulnar artery.

d The deep palmar arch lies superficial to the palmar aponeurosis.

e The deep palmar arch usually lies proximal to the superficial palmar arch.

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b) Blood supply to the hand is poor, and laceration will usually result in only mild bleeding.
c) The deep palmar arch is formed primarily from the ulnar artery.
d) **The deep palmar arch lies superficial to the palmar aponeurosis.** ✗
e) The deep palmar arch usually lies proximal to the superficial palmar arch. ✓

Answer

The deep palmar arch usually lies proximal to the superficial palmar arch.

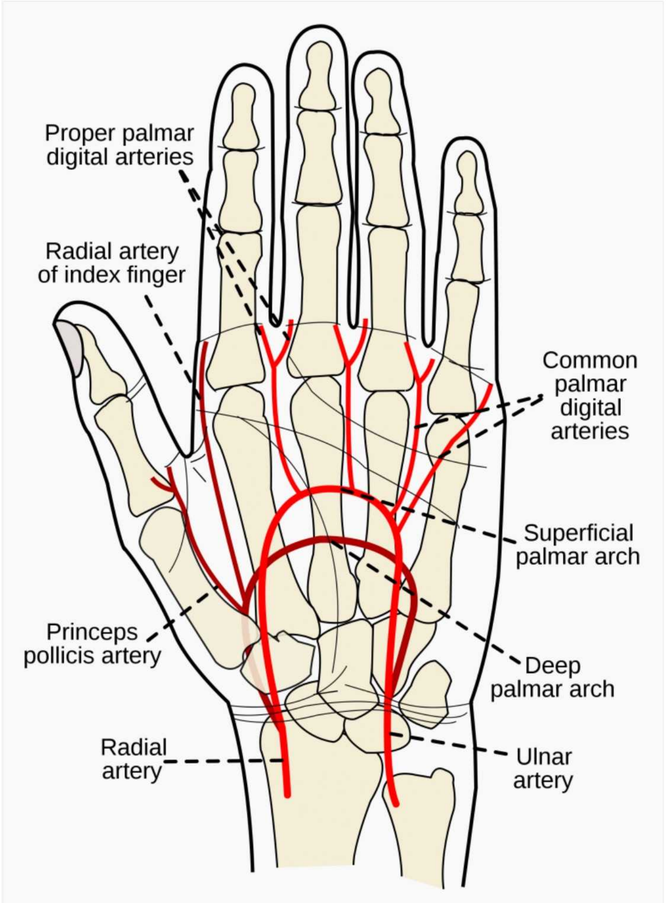
Notes

There are two palmar arches which supply the hand.

The ulnar artery forms the superficial palmar arch which communicates laterally with a palmar branch of the radial artery. The superficial palmar arch lies superficial to the long flexor tendons of the digits and just deep to the palmar aponeurosis. It is located across the centre of the palm, about level with the distal border of the extended thumb.

The radial artery forms the deep palmar arch which communicates medially with the deep palmar branch of the ulnar artery. The deep palmar arch lies between the metacarpal bones and the long flexor tendons of the digits. It is located approximately 1 cm proximal to the superficial palmar arch.

Laceration to the palmar arches results in profuse bleeding.



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Anatomy: Forearm and Hand



Question 96 of 102

A 34 year old man sustains an injury to the proximal median nerve following a stab wound to the forearm. Which of the following muscles would you least expect to be affected:

a Pronator teres

b Flexor digitorum profundus

c Flexor pollicis longus

d Abductor pollicis brevis

e Flexor digiti minimi

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Anatomy: Forearm and Hand



Question 97 of 102

A 57 year old woman presents to the ED complaining of pain in her wrist associated with tingling in her hand. You suspect carpal tunnel syndrome. Which of the following structures does NOT pass through the carpal tunnel into the hand:

a Tendons of the flexor digitorum superficialis

b Tendons of the flexor digitorum profundus

c Tendon of the flexor pollicis longus

d Ulnar artery

e Median nerve

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Anatomy: Forearm and Hand



Question 97 of 102

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a) Tendons of the flexor digitorum superficialis
b) Tendons of the flexor digitorum profundus
c) Tendon of the flexor pollicis longus
d) **Ulnar artery** ✔
e) Median nerve

Answer

The tendons of the flexor pollicis longus, flexor digitorum superficialis and flexor digitorum profundus pass through the carpal tunnel together with the median nerve. The ulnar nerve and ulnar artery pass into the hand anterior to the flexor retinaculum and carpal tunnel.

Notes

Anatomical Boundaries	Structure
Roof	Flexor retinaculum
Carpal arch	Pisiform and hook of the hamate medially, tubercles of the scaphoid and trapezium laterally
Contents	Four tendons of flexor digitorum profundus, four tendons of flexor digitorum superficialis, tendon of flexor pollicis longus, median nerve

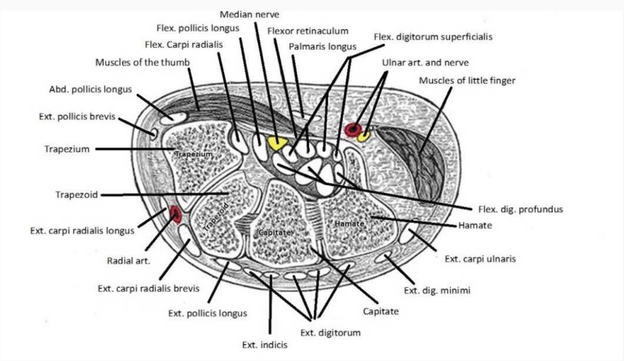
The carpal tunnel is formed by a deep carpal arch and a superficial flexor retinaculum. The base of the carpal tunnel is formed medially by the pisiform and the hook of the hamate and laterally by the tubercles of the scaphoid and trapezium. The flexor retinaculum is a thickened band of fibrous connective tissue on the volar aspect of the hand, which bridges the gap between these carpal bones and forms the roof of the carpal tunnel.

The following structures pass through the carpal tunnel:

- the four tendons of the flexor digitorum profundus (FDP)
- the four tendons of the flexor digitorum superficialis (FDS)
- the tendon of the flexor pollicis longus (FPL)
- the median nerve.

Free movement of the tendons in the carpal tunnel is facilitated by synovial sheaths, which surround the tendons. All of the tendons of the FDP and FDS are contained within a single synovial sheath with a separate sheath enclosing the tendon of the FPL. The median nerve lies anterior to the tendons in the carpal tunnel.

Carpal tunnel syndrome is caused by compression of the median nerve within the carpal tunnel.



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Anatomy: Forearm and Hand



Question 98 of 102

A 23 year old man presents to the ED after cutting his forearm. On examination there is a deep laceration with an arterial spurt. You suspect an ulnar artery injury. Regarding the ulnar artery, which of the following statements is INCORRECT:

a The ulnar artery passes down the forearm between the flexor carpi ulnaris and the flexor pollicis longus muscle.

b The ulnar artery enters the hand passing lateral to the pisiform bone.

c The ulnar artery passes anterior to the flexor retinaculum.

d The ulnar artery gives rise to the common interosseous artery.

e The ulnar artery is a branch of the brachial artery.

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c) The ulnar artery passes anterior to the flexor retinaculum.

d) The ulnar artery gives rise to the common interosseous artery.

e) The ulnar artery is a branch of the brachial artery.

Answer

The larger ulnar artery, also a branch of the brachial artery, enters the forearm by passing deep to the pronator teres muscle and passes down the medial side of the forearm between the flexor carpi ulnaris and the flexor digitorum profundus muscles. The ulnar artery enters the hand, passing lateral to the pisiform bone and superficial to the flexor retinaculum. The ulnar artery gives rise to the common interosseous artery.

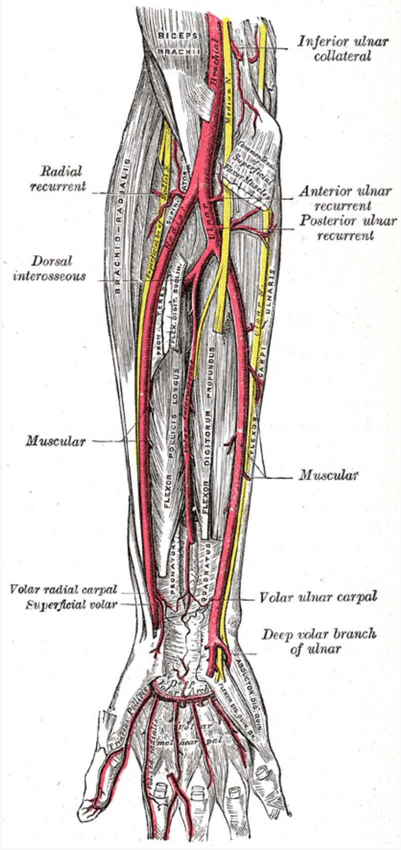
Notes

The radial artery, branch of the brachial artery, passes along the lateral aspect of the forearm, lying deep to the brachioradialis muscle proximally, and distally being covered only by skin and fascia, making this an ideal location to palpate the pulse or to gain arterial access (palpated just lateral to the flexor carpi radialis tendon, while compressing the artery against the radius bone). The radial artery enters the hand by curving around the lateral side of the wrist, passing over the floor of the anatomical snuffbox and penetrating the dorsolateral aspect of the hand between the bases of the first and second metacarpal bones.

The larger ulnar artery, also a branch of the brachial artery, enters the forearm by passing deep to the pronator teres muscle and passes down the medial side of the forearm between the flexor carpi ulnaris and the flexor digitorum profundus muscles. The ulnar artery enters the hand, passing lateral to the pisiform bone and superficial to the flexor retinaculum. The ulnar artery gives rise to the common interosseous artery.

The palmar and dorsal carpal arches are formed from anastomosis between the carpal branches of the radial and ulnar arteries, and supply the wrist and carpal bones.

Deep veins of the anterior compartment generally accompany the arteries and ultimately drain into brachial veins associated with the brachial artery in the cubital fossa.



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Anatomy: Forearm and Hand



Question 99 of 102

A 67 year old woman presents to the ED after falling onto an outstretched hand. You x-ray her left wrist and note no fracture. You discuss the case with your consultant, he advises you to test for anatomical snuffbox tenderness. The anatomical snuffbox is bounded medially by the tendon of which of the following muscles:

a Extensor pollicis longus

b Extensor pollicis brevis

c Abductor pollicis longus

d Adductor pollicis

e Abductor pollicis brevis

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a) Extensor pollicis longus ✔
b) Extensor pollicis brevis
c) Abductor pollicis longus
d) Adductor pollicis
e) Abductor pollicis brevis

Answer

The anatomical snuffbox is bounded medially by the tendon of the extensor pollicis longus.

Notes

The anatomical snuffbox is the triangular depression formed on the posterolateral side of the dorsal wrist and 1st metacarpal by the extensor tendons passing into the thumb.

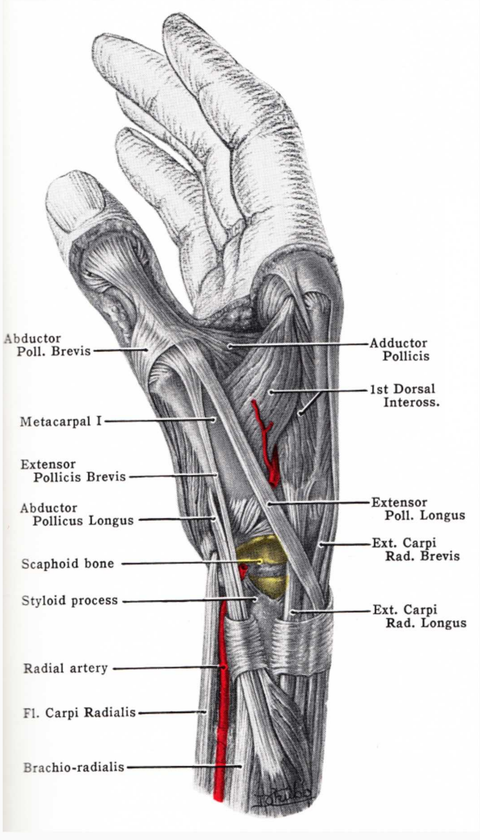
Anatomical Boundaries	Structure
Medial border	Tendon of extensor pollicis longus
Lateral border	Tendons of the abductor pollicis longus and extensor pollicis brevis
Proximal border	Radial styloid process
Distal border	1st metacarpal
Floor	Scaphoid and trapezium bones
Roof	Skin
Contents	Radial artery, terminal portion of the superficial branch of the radial nerve, cephalic vein

It is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis and medially by the tendon of the extensor pollicis longus.

The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

The radial artery crosses the floor of the anatomical snuffbox. Subcutaneously terminal parts of the superficial branch of the radial nerve and the origin of the cephalic vein pass over the anatomical snuffbox.

The anatomical snuffbox is important clinically as the scaphoid is palpable within the snuffbox; localised pain and tenderness of the anatomical snuffbox is most likely due to a scaphoid fracture.



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Anatomy: Forearm and Hand



Question 100 of 102

A 67 year old patient complains of weakness of abduction and adduction of his fingers. You suspect weakness of the interossei. Regarding the interosseous muscles, which of the following statements is INCORRECT:

a The interossei lie between and attached to the metacarpals.

b The interossei insert into the extensor hoods of the fingers.

c There are three palmar and four dorsal interossei.

d The interossei are innervated by the ulnar nerve.

e The dorsal interossei adduct the fingers.

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Anatomy: Forearm and Hand



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a) The interossei lie between and attached to the metacarpals.
b) The interossei insert into the extensor hoods of the fingers.
c) There are three palmar and four dorsal interossei.
d) The interossei are innervated by the ulnar nerve.
e) **The dorsal interossei adduct the fingers.** ✔

Answer

The four dorsal interossei act to abduct the index, middle and ring fingers, and the three palmar interossei act to adduct the thumb, index, ring and little fingers. (DAB, PAD).

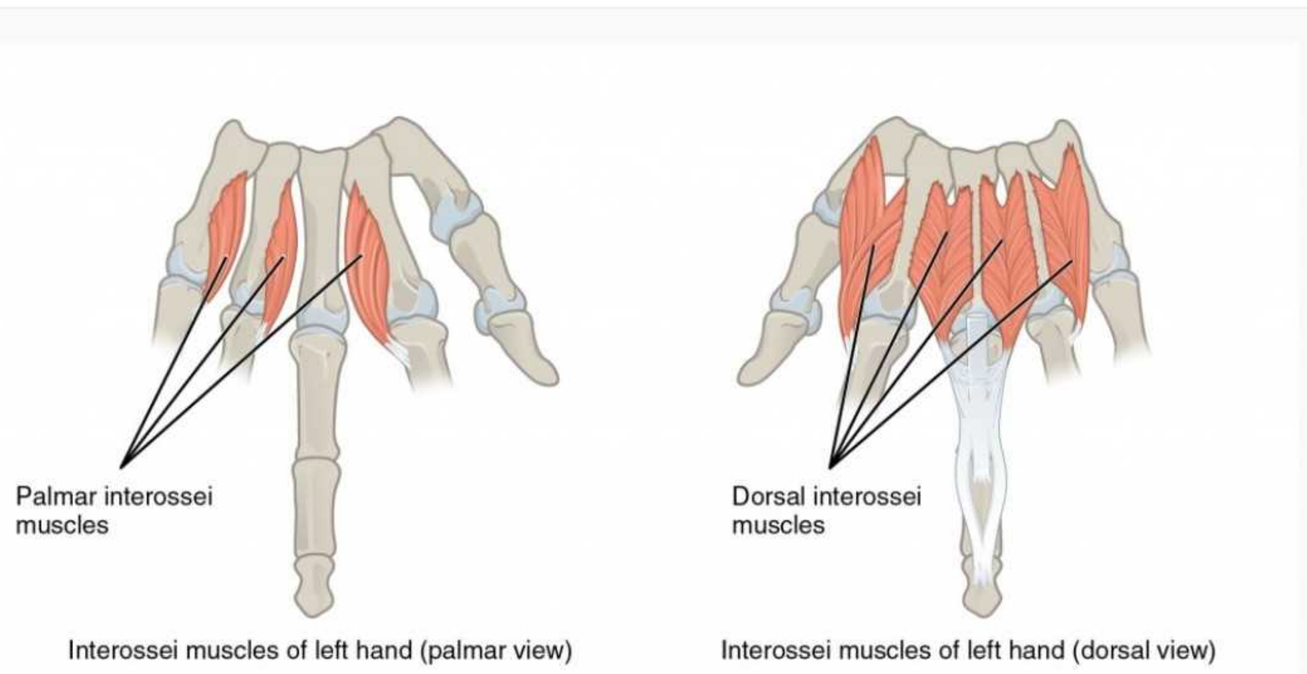
Notes

The interosseous muscles originate from and lie between the metacarpal bones. The dorsal interossei insert into the extensor hoods and proximal phalanges of the index, middle and ring finger. The palmar interossei insert into the extensor hoods of the index, ring and little finger.

The four dorsal interossei act to abduct the index, middle and ring fingers, and the three palmar interossei act to adduct the index, ring and little fingers. (DAB, PAD). Because the interosseous muscles insert into the extensor hoods, they also contribute to the complex flexion and extension movements of the interphalangeal joints of the digits.

The interosseous muscles are all innervated by the ulnar nerve.

Muscle	Action	Innervation
Dorsal interossei	Abduction of fingers at MCPJ	Ulnar nerve
Palmar interossei	Adduction of fingers at MCPJ	Ulnar nerve



Interossei muscles of left hand (palmar view) Interossei muscles of left hand (dorsal view)

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Anatomy: Forearm and Hand



Question 101 of 102

A 31 year old lady slipped on a wet bathroom floor and fell onto her outstretched hand. She is tender over the anatomical snuffbox and imaging shows a fracture of the scaphoid bone. Which of the following structures is most likely to be damaged in this type of injury:

a Brachial profunda artery

b Ulnar artery

c Radial artery

d Princeps pollicis artery

e Deep palmar arterial arch

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Question 101 of 102

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a) Brachial profunda artery
b) Ulnar artery
c) Radial artery ✔
d) **Princeps pollicis artery** ✘
e) Deep palmar arterial arch

Answer

The radial artery passes over the floor of the anatomical snuffbox, just superior to the scaphoid bone and hence it is the most likely to be injured in this type of injury. Once in the hand the radial artery divides into the princeps pollicis artery and the deep palmar arterial arch.

Notes

The anatomical snuffbox is the triangular depression formed on the posterolateral side of the dorsal wrist and 1st metacarpal by the extensor tendons passing into the thumb.

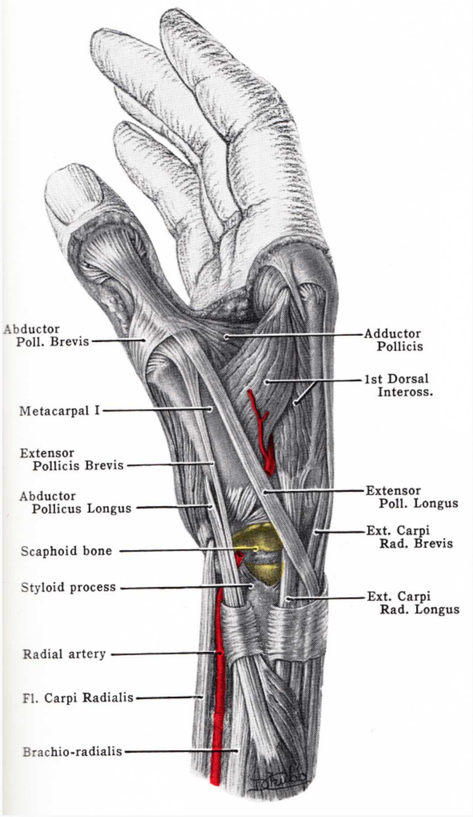
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Proximal border	Radial styloid process
Distal border	1st metacarpal
Floor	Scaphoid and trapezium bones
Roof	Skin
Contents	Radial artery, terminal portion of the superficial branch of the radial nerve, cephalic vein

It is bounded laterally by the tendons of the abductor pollicis longus and the extensor pollicis brevis and medially by the tendon of the extensor pollicis longus.

The floor of the anatomical snuffbox is formed by the scaphoid and trapezium carpal bones. The radial styloid process can be palpated proximally and the 1st metacarpal can be palpated distally.

The radial artery crosses the floor of the anatomical snuffbox. Subcutaneously terminal parts of the superficial branch of the radial nerve and the origin of the cephalic vein pass over the anatomical snuffbox.

The anatomical snuffbox is important clinically as the scaphoid is palpable within the snuffbox; localised pain and tenderness of the anatomical snuffbox is most likely due to a scaphoid fracture.



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Anatomy: Forearm and Hand



Question 102 of 102

You have been asked to give a tutorial to a group of nurses regarding venous cannulation. As part of the session you cover the basic anatomy of the venous system of the arm. Regarding the superficial veins of the upper limb, which of the following statement is CORRECT:

a The cephalic vein arises from the ventral venous network.

b The cephalic vein ascends along the medial forearm and arm.

c The basilic vein arises from the medial aspect of the dorsal venous network.

d The basilic vein ascends along the posterior forearm and arm.

e The cephalic and basilic vein drain into the median cubital vein in the upper arm.

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a) The cephalic vein arises from the ventral venous network.
b) The cephalic vein ascends along the medial forearm and arm.
c) The basilic vein arises from the medial aspect of the dorsal venous network. ✔
d) The basilic vein ascends along the posterior forearm and arm.
e) **The cephalic and basilic vein drain into the median cubital vein in the upper arm.** ✖

Answer

The basilic vein arises from the medial aspect of the dorsal venous network, ascends along the medial aspect of the forearm and arm and becomes the axillary vein.

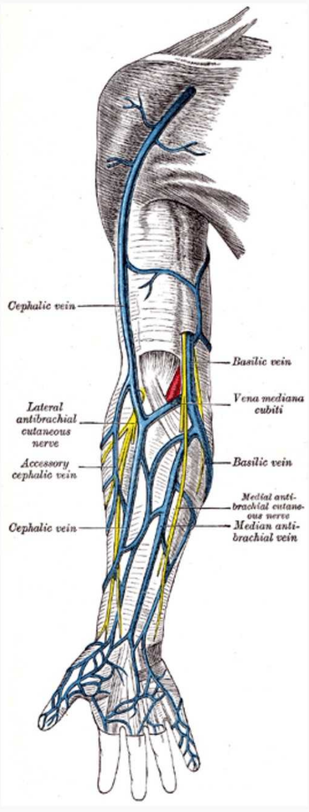
Notes

The cephalic, basilic and median cubital veins are the main superficial veins of the upper limb.

The cephalic vein arises from the lateral aspect of the dorsal venous network, ascends along the anterolateral border of the forearm and arm and drains into the axillary vein.

The basilic vein arises from the medial aspect of the dorsal venous network, ascends along the medial aspect of the forearm and arm and becomes the axillary vein.

The two superficial veins communicate via the median cubital vein which passes obliquely across the anterior elbow in the antecubital fossa. The median cubital vein is a common site of venepuncture.



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